THROUGH RED AT AMSTERDAM CENTRAL

(21 May 2004)

The Hague, June 2005

THE DUTCH SAFETY BOARD

The Dutch Safety Board is an independent administrative body and individual legal entity instituted in Dutch law and tasked with investigating and determining the causes or probable causes of individual incidents or categories of incidents in all sectors. The sole objective of such investigations is to prevent future accidents or incidents, and if considered meaningful on the basis of the results, to duly issue recommendations. The organisation consists of a Board with five permanent members and ten permanent committees. For specific investigations, special Supervisory Committees are appointed. The Board is supported by an office consisting of researchers, secretary-rapporteurs and support staff.

The Safety Board is the legal successor to the Council for Transport Safety. The present investigation was carried out by the Council for Transport Safety but is being published under the auspices of the Safety Board.

Visitors' address:	Anna van Saksenlaan 50 2593 HT The Hague	Correspondence address	P.O. Box 95404 2509 CK The Hague
Telephone:	+31 (0)70 333 7000	Fax:	+31 (0)70 333 7077
Internet:	http:/ www.onderzoeksraad.nl		

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BACKGROUND

BACKGROUND

Traffic lights on the public highway have a completely different meaning than signals beside railway tracks. If traffic lights on the public highway fail, traffic simply continues to drive according to normal traffic rules. On the railways, this is not the case. If the signals fail, no more trains can move. The signals alongside railway tracks have an absolutely binding character. Unlike car drivers or tram operators, trains do not drive by sight; trains travel according to signals. The braking distance of a train is too long to be able to drive by sight. The instructions issued by signals must therefore always and unconditionally be complied with. This is essential for railway safety.

In 1962, two trains collided head on in Harmelen, with terrible consequences. The Railways Accident Board, following an investigation, concluded that the cause of the collision was the incorrect passing of a stop signal. Until the collision in Harmelen, there had always been total trust in the strict compliance with signals by drivers (red light discipline). In comparison with 1839, when rail transport first started, train frequencies, train speeds and train length had risen tremendously, by 1962. The Railways Accident Board therefore concluded that the existing system was no longer sufficient, and that a technical catch net was required, to avoid driver errors of this kind. The Minister complied with these recommendations. The Dutch railway network was equipped, following the collision in Harmelen, with a system of Automatic Train traffic control (ATB – First Generation).

In 1992, the Railways Accident Board issued a report of an investigation following a collision in Eindhoven (1992). This investigation suggested that the ATB system offered insufficient protection measures to prevent accidents such as that in Eindhoven. The system turned out to be outdated. The then Netherlands Railways recognised this fact, and suggested that work was well underway on an ATB system, New Generation. In 1999, a further serious accident occurred in Dordrecht. In 2001, the Council for Transport Safety issued a report following this collision, whereby a stop signal had been passed. In the report, in the same way as after the “Eindhoven” incident, the Council suggested that the ATB system was out of date; a new system was urgently required. The investigation suggested that in just five years time, the number of times a train had passed a red signal (Stop Signal / STS) had doubled from approximately 150 to almost 300 per year. The core of the response from the Minister to the “Dordrecht” report reads:

> *“…..… It can be concluded from this that replacement will not take place only on the basis of safety considerations …..Given the costs involved in replacement (several billion euros if introduced across the whole of the Netherlands), and the minimal advantages for safety, other decisive arguments will have to be put forward, such as quality improvement, capacity management and interoperability …. In summary, therefore, I can inform you that work is being carried out in the spirit of the recommendations, but that we cannot issue any concrete plans within the timeframe you suggest.”*

On 21 May 2004, another serious train collision occurred, in Amsterdam. Right from the start, everything pointed towards another STS passage. On 27 May 2004, in a letter to the Lower Chamber of the Dutch Parliament, the Council for Transport Safety stated, *‘It would absolutely be launching an investigation’* but added the footnote that *‘however, should it emerge from the investigation that the Council is faced with the shortcomings resulting from the existing ATB system* **–** *as previously noted* **–** *the question emerges as to whether the investigation should indeed be continued.*’ Given the fact that the structural safety shortcomings resulting from the existing ATB system are sufficiently well-known amongst the parties involved, in combination with the above reaction from the Minister to the “Dordrecht” recommendations in respect of replacement of the ATB system, the Council continues to have doubts about the repeated, fundamental investigation of the STS problem.

Shortly after the collision in Amsterdam on 21 May 2004, it became clear that an empty double decker train had been involved in a head-on collision with an intercity train, after the empty double decker train had passed a red signal. In the collision, 19 passengers were injured. The damage to the infrastructure was massive. Immediately following the accident, Amsterdam Central Station was taken out of service. The square in front of the station was also evacuated, as a result of which much tram traffic in the entire city was disrupted.

The investigation into “Amsterdam” indicated that the previously identified severe rise in the number of red light passages was practically a logical consequence of a number of social and technical developments, namely:

- In 1988 (seven years before the split-up in 1995), the Netherlands Railways presented the ‘Rail 21’ plan. This plan foresaw a doubling in the number of passengers and an increase in train traffic of 50 percent. This called for a necessary expansion of the infrastructure, to the tune of 8 billion euro. Broadly speaking, this plan was implemented. For the existing network, two systems had to be developed. One was the Transport by Train (Vervoer Per Trein - VPT) system and the other was a new control system, the ATB New Generation. The purpose of the VPT system was to facilitate higher train frequencies (for example by using subroutes). The objective of the second system, the ATB New Generation, was to cover the increased risks resulting from the higher train frequencies, by introducing a system that did not suffer from the structural shortcomings of the ATB First Generation.

- The VPT system that makes possible higher train frequencies was introduced in 1995. Above all as a result of European developments, the ATB New Generation was not introduced on the main network. At a hearing held following the investigation by the Council into the collision in Eindhoven in 1992, the management of the Netherlands Railways indicated that they expected the rapid introduction of ATB New Generation[1]. This system is able to prevent accidents because part of the system provides for continuous automatic speed control. This means that the speed of the train from the point of departure is continuously monitored, to determine whether the speed is low enough such that with the available braking capacity and the still remaining braking distance, it is possible to bring the train to a halt before the red light. As soon as the speed of the train is in danger of rising too high, the system immediately automatically brakes the train to a suitable speed in the given situation. Trains with continuous automatic speed control can under normal circumstances not pass a red signal (STS).

- As a result of the introduction of the ‘Rail 21’ plan, train frequencies have risen considerably, over time. As a result, the risks of passing a red signal have also increased. The increase in train frequencies was made possible by the VPT system. Thanks to this system, optimum use is made of the available track capacity, for example by setting subroutes. The setting of subroutes, which before 1995 practically never happened, engenders risks for STS passages. If the ATB New Generation system had been introduced simultaneously, increased frequency and the setting of subroutes would not have been a problem in respect of STS passages. A system of continuous automatic speed control would have covered those additional risks. The risk of STS passages has however risen unacceptably high, because this system was not introduced.

The reply from the Minister to the recommendations from the Council for Transport Safety, quoted above, effectively means that passenger safety does not justify the high costs of a modern control system. Maintaining (and not increasing) the existing level of safety was the point of departure for ‘Rail 21’. The doubling of the number of STS passages, and 14 serious collisions since “Dordrecht” [2] is clear evidence of a fall in the level of safety, as a consequence of which the position of the Minister in respect of the introduction of a new control system is out of line with the point of departure relating to safety. In addition, this position is out of kilter with the plan Rail 21.

In rail transport, alongside the Minister of Transport, Public Works and Water Management as policy maker and the Transport and Water Management Inspectorate as supervisory body for compliance with the rules, ProRail as expert rail infrastructure manager and the operators play a crucial task in respect of safety. Society expects each of these parties to take their own responsibility, based on their own professional standards, in respect of safety, whereby the continuous striving is to improve the level of safety, in a transparent manner. This is indeed expressed literally in the regulations formally introduced at the start of this year. Within the safety framework laid down by the Ministry of Transport, Public Works and Water Management, ProRail and the operators are required to work demonstrably as safely as possible, whilst continuously creatively searching for safety improvements.

[1] This also emerged from the plan Rail 21.
[2] See photographs appendix 1.

However, this investigation has once again confirmed the doubts of the Council for Transport Safety arisen in 2001 following the “Dordrecht” investigation, concerning the priority for safety by ProRail and the operators, and as a consequence the way in which they fulfil their responsibility for rail safety. It has also emerged that following the recommendations from the Council after “Dordrecht” (1999), neither the Minister nor ProRail or the operators have taken effective measures to restrict the increased number of STS passages. Various possibilities for reducing the number of STS passages have remained unexploited. For example, the training requirements for drivers were lowered in 1999. In addition, drivers have been provided with a whole range of equipment which distracts their attention whilst driving. Furthermore, no structural investigation or analysis are carried out into the driving behaviour of drivers, and there is no structural feedback to drivers.

The circumstances within which the operators and ProRail work do not contribute to any continuous improvement or optimisation of the safety level. There are no solid agreements between the Minister on the one hand and ProRail and the operators on the other. There is no concretisation of the duty of care for safety, and the supervisory task of the Transport and Water Management Inspectorate (IVW) is only implemented to a limited extent.

Although there already was an STS working group, it took until 2004, after twelve STS accidents since the “Dordrecht” accident, before ProRail and the operators, at the personal initiative of the Minister, came up with a serious sector-wide approach to the STS problem in the new STS working group, in which the Ministry, the operators, IVW and ProRail are represented. This working group has now submitted a technical solution according to which, in their own words, the STS passage problem could be significantly reduced. The Council considers it likely that as a result the STS problem will be reduced, and appreciates the fact that the Minister has formalised this proposal in a letter to the Lower Chamber (dated 17-5-2005). The Council however continues in its belief that the STS problem should also be tackled at a structural level, by introducing continuous automatic speed control, which for example is one of the components of the ETCS system or ATB New Generation. The Council therefore continues to uphold its previous recommendation that trains on the Dutch railway network should be equipped with continuous automatic speed control.

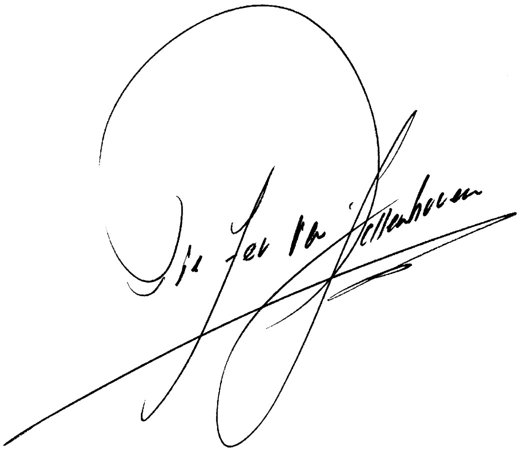
From the technical part of this investigation, it has also emerged that the way in which the punctuality of train services is currently measured encourages the use of subroutes. In punctuality measurement, departure times and arrival times are considered. A subroute offers the possibility of at least earlier departure, even if the next section of the journey is blocked.

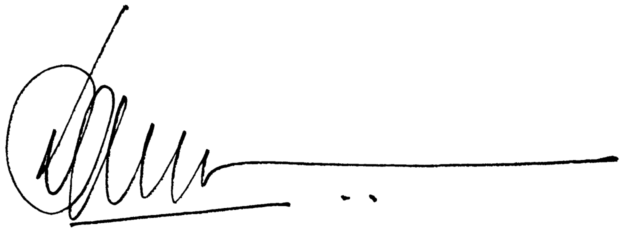
The investigation by the Council has led to the following recommendations:

1. The Minister of Transport, Public Works and Water Management, ProRail, the operators and the Transport and Water Management Inspectorate are recommended to supervise implementation of the STS reduction plan of the STS working group, by critically monitoring and evaluating the progress and the results, and working on a renewed European ATB system for the long term, whereby the speed of trains is automatically continuously controlled.
2. The Minister of Transport, Public Works and Water Management is recommended, to that end, to draw up a concrete plan, in which a timetable is included, laying down the implementation of continuous automatic speed control.
3. ProRail and the operators are recommended to take up and put into practice their own responsibility for safety, by demonstrating that they operate as safely as possible (ALARP[3]) within the possible safety limitations of the railway system (ATB, visibility of signals, rail characteristics, etc.). However, they should nonetheless work progressively and creatively on solving these problems. In this respect, they should not in advance exclude drastic measures (e.g. reducing train frequencies) and communicating clearly on these decisions with the Ministry of Transport, Public Works and Water Management, as the body responsible for the system.
4. The Minister of Transport, Public Works and Water Management is recommended to improve the effectiveness of guidance and inspection of ProRail and the operators, by under all circumstances:
   - formulating clear, company-specific safety targets (for example concrete reduction in the number of STS passages), which are ‘compulsory’ for the parties involved;

[3] As low as reasonably practicable.

- explicitly basing concessions, safety certificates and supervision on the assessment of the quality of application in daily practice of the safety management system of the parties involved[4];
- undertaking an evaluation of the degree to which the safety certificate has contributed to the quality of safety management and the safety culture of the operators.
- altering the measurement of train punctuality in such a way that in determining punctuality of rail traffic, only the arrival time of trains is counted and not as is currently the case also the departure time.





mr. Pieter van Vollenhoven

Board Chair

ir. D.A. van den Wall Bake

General Secretary acting

[4] As necessary, consequences should be attached in the form of withdrawing the concessions.

1. INTRODUCTION

On 21 May 2004, in the eastern complex at Amsterdam Central station, an empty double decker train collided with an intercity passenger train (Heerlen – Haarlem). The immediate cause of the collision was that the empty double decker train, which was being transferred from the station to a stabling zone, had passed a red signal, shortly before the collision. As a result of the collision, 19 passengers from the intercity train were so severely injured that they had to be transferred to hospital. The damage to the track and the trains was massive.

On 27 May 2004, in a letter to the Lower Chamber of the Dutch Parliament, the Council for Transport Safety stated that '*in the case of such a serious accident, the Council will always launch an investigation into the causes'*. However, if it emerges that this collision was once again due to an STS passage, the question emerges as to whether a fundamental investigation into the underlying causes is still necessary. These underlying causes have been described in detail in investigation reports for comparable train collisions as a result of the passing of stop signals (Eindhoven Railways Accident Board 1992, Dordrecht Council for Transport Safety 1999).

Following the train accidents in Dordrecht and Eindhoven, the Council issued recommendations to the parties involved to take measures to reduce the number of red light passages, the so-called Stop Signal (STS) passages. In these recommendations, reference was made to the sharp rise in the number of STS passages. Since 1995, the number of STS passages has been rising, year on year. Until 1995, this number had averaged 150 a year. In 1999, the number had risen to 230 a year. Since that time, the rise has continued unabated. The number of identified STS cases in 2004 totalled 283. As a result of passing an STS, in the period since 1999 (since the collision in Dordrecht), to date, 14 serious accidents have occurred. To date, after passing a stop signal, there has been one fatality, and very considerable material damage. However, STS passages engender such a serious potential risk that large numbers of fatalities are a clear possibility.

The recommendations of the Council following the train accidents in Dordrecht and Eindhoven referred to three aspects, which turn out once again to play an important role in the investigation into "Amsterdam".

A first aspect on which the Council and Railways Accident Board have issued recommendations is the railway control system. In the investigations into the accidents in Eindhoven and Dordrecht, it was determined that the existing control system, the so-called ATB system First Generation, installed on a large proportion of the Dutch railway network, is outdated and offers insufficient protection. Following the serious railway accident in Harmelen (1962), it was decided to introduce this ATB system in the Netherlands, which had been developed in the 1950s. The ATB system however suffers from two major limitations. The ATB system (i) does not monitor whether sufficient braking has been undertaken, and (ii) does not operate at speeds below 40 km/hour. To eradicate these limitations, an ATB system New Generation has been developed, equipped with continuous automatic speed control, which in normal circumstances makes it impossible to pass a stop signal. On those track sections in the Netherlands which are equipped with an ATB system New Generation, not a single STS passage has been identified. One of the recommendations arising from "Dordrecht" to the Minister was to lay down the phasing for the implementation of such a modern control system on the Dutch railways. In response to the recommendations from Council, the Minister suggested (on 28 April 2003) *'….. it can be concluded from this that the replacement will not take place only on the basis of safety considerations.."* and that *"we cannot issue any concrete plans…".*

A second aspect which was investigated at both "Eindhoven" and "Dordrecht" is the influence of the setting of subroutes, on the passing of stop signals. This aspect refers to the setting of part of the overall route from platform to open track. Because being offered a relatively short route often does not tie in with the expectation pattern of the driver, in the Dordrecht report, the Council recommended reticence in setting such subroutes, as had been the case before 1995. The accident in Amsterdam also involved a subroute.

A final aspect relates to the 'red light discipline' of drivers. In the investigations into "Eindhoven" and "Dordrecht", it was specified that strict compliance with signals at red by drivers has since the birth of the railways represented a key factor in the safety of railway traffic. Because to a considerable extent safety on the railways is determined by this ‘red light discipline’ of drivers, it was recommended that ‘red light discipline’ should be given a central focus in the railway sector. It was recommended that the way in which this discipline be dealt with should be improved.

The Minister of Transport, Public Works and Water Management had the train collision in Amsterdam investigated by its own inspectorate. The results of this investigation by the Transport and Water Management Inspectorate were published at the end of June 2004. The investigation by the Inspectorate into the train collision was, in the judgement of the Council, accurately implemented. For this reason, the Council did not repeat this part of the investigation, but considered an assessment of the investigation results sufficient. The conclusion of the IVW was that on 21 May 2004, in Amsterdam, shortly before the collision, a red signal had been passed. The Council underwrites this conclusion by the IVW in respect of the immediate cause. The purpose of this investigation is therefore to place the STS passage in Amsterdam in a broader perspective. In this respect, the primary question which emerges is why the recommendations from the “Dordrecht” report did not have the intended effect, and why it has taken so long (and so many accidents) before serious action has been taken, across the board within the industry. For this reason, in our investigation, we have above all concentrated on how the parties involved responded to the recommendations from the “Dordrecht” report, and how these responses relate to the expectations in respect of the individual responsibility of the Ministry of Transport, Public Works and Water Management, ProRail and the operators. This report contains the results of that investigation.

2. CIRCUMSTANCES OF THE ACCIDENT IN AMSTERDAM

On Friday 21 May 2004 at 18:35 hours, a head-on collision took place in the eastern section of Amsterdam Central station, between an intercity train heading towards the station (on the Heerlen-Haarlem route) and an empty double decker train departing from the station. In this collision, 19 passengers from the intercity train were injured so severely that they had to be transported to hospital. There was also massive damage to rolling stock and the railway infrastructure (see figure 1) and all train traffic was closed down for a full 24-hour period.

The intercity train operated by NS Passengers, number '960', consisted of a locomotive and nine carriages, and was travelling from Amsterdam Amstel station. According to the timetable, the intercity train was due to arrive at Amsterdam Central station at 18:34 hours. The number of passengers on the train at the time was in excess of one hundred. Because it was the Friday after Ascension Day, the train was considerably quieter than on a normal Friday evening.

On the approach to Amsterdam Central, the intercity train passed two signals, both at 'green'. At that moment, the time was 18:31 hours, and the train was travelling at a speed of approx. 40 km/hour on track 71 heading for the planned arrival platform 4b/a (see figure 2).

Figure 1: The first carriage behind the locomotive of the intercity train, as it came to rest.

A double decker train operated by NS Passengers, number '80761' travelling from Utrecht as a passenger train arrived at Amsterdam Central station at platform 5b. After disembarking the passengers, the train was to be transferred empty to the stabling zone Watergraafsmeer. This stabling zone is located several kilometres east of Amsterdam Central station. The planned departure time for the double decker train was 18:30 hours from platform 5b (see figure 2). The double decker train was driven to the Watergraafsmeer stabling zone by a driver with limited authority[5] based in Amsterdam. The driver in question had one year's independent driving experience.

Train traffic control in Amsterdam Central and districts is implemented from the train traffic control post in Amsterdam Central (VLTC building). The train traffic controller 'East' is responsible for train traffic to the east of Amsterdam Central.

At around 18:25 hours, the train traffic controller 'East' returned from his break. Shortly afterwards, the driver of the empty double decker train reported his presence on track 5b, via Telerail[6] to the train traffic controller. The driver stated that he was ready to depart. To make this possible, the route to be travelled by the train had to be set for the train. To set such routes, use is made of the Transport By Train (VPT) system. This VPT system, which consists of complex computer systems and software systems, was required to automatically set a route for the empty double decker train, at 18:30 hours. Because the train traffic controller had not at that time completed all administrative tasks[7] necessary for setting a route, the VPT system was not able to automatically set a route for the departing double decker train, at around 18:30 hours.

At that same moment, the intercity train reported in according to the timetable. Because all conditions were met, the VPT system was able to automatically set a route for the intercity train at 18:30 hours, from track 71 heading for platform 4a at the station (see figure 2).

[5] The limited authority means that the driver is authorised to drive trains independently, without passengers, within Amsterdam Central and the peripheral area. A driver with limited authority has concluded part of the training programme for train drivers, and is acquiring driving experience, before starting the next stage.

[6] Telerail is a communication system according to which the train traffic controller and driver are able to communicate via a secure link. Communication is possible via a selective, general or alarm call. The Telerail system was nationally introduced in the 1980s.

[7] This involved inputting the train number.

Because the VPT system was unable to automatically set a route for the double decker train, the train traffic controller himself set a route, manually. The train traffic controller first manually set a subroute from track 5b to track 5c, as far as signal 278. When the train traffic controller subsequently wished to set the second section of the route, to signal 278, he noticed this was not possible. The reason for this was that the VPT system had shortly beforehand automatically already set a route for the intercity train from track 71 to track 4b. The double decker train and the intercity, according to the planned routes, would then both be making use of the same section of track (in opposite directions). Such conflicting routes are not permitted by the system. The set routes are indicated with green arrows, in figure 2.

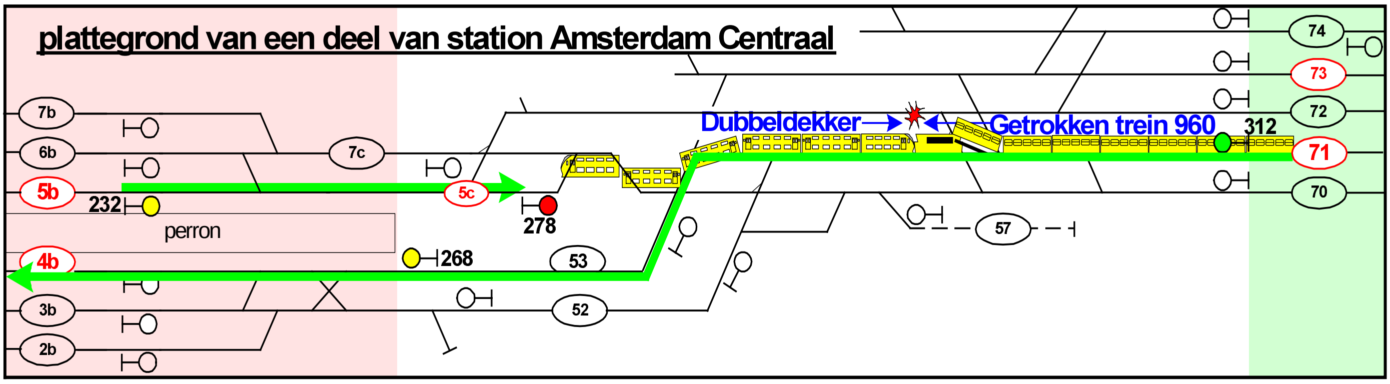


Figure 2: On 21 May 2004, an empty double decker train, following its departure, passed through signal no. 278 at red, and collided head-on with an incoming intercity from Utrecht. For the intercity, a complete route was set from track 71 (open track) to track 4b (platform track). For the double decker, a subroute was set from track 5b (platform track) as far as signal 278 (gridiron). The train was required to transfer to track 73 (open track: the continuous automatically set route to the next station).

The driver of the double decker train saw signal 232 on track 5b switch from the stop setting (see figures 2 and 3). The driver set the train in motion, and switched to the permitted speed of 40 km/hour.

The train traffic controller wished to inform the driver of the departing double decker train that he had only been able to set a subroute, namely from track 5b as far as signal 278 (see figures 2 and 3). At that same moment, the train traffic controller saw on his screen that the double decker train had incorrectly passed the red signal 278.

At the same moment that the double decker train passed the red signal 278, the intercity train travelling from Utrecht was passing entry signal 312 (the first operable signal at Amsterdam station). This meant that the intercity train and the double decker train were about to meet in a head-on collision, without passing any further signals.

Figure 3: The view of the driver of the departing double decker train from the cabin, when leaving before the route setting.

When the driver of the intercity train noted that the collision was no longer avoidable, he operated the brake handle and dived under his steering table. The driver of the double decker train also operated the brake handle, and immediately exited the cabin. Both trains were travelling at approx. 40 km/hour at that time. Within just a few seconds, the head-on collision took place. Due to the minimal time, there was almost no braking, as a result of which the speed did not fall to any notable extent. The time at the moment of collision was 18:32:13 hours.

3. PARTIES AND THEIR RESPONSIBILITIES

This chapter briefly outlines the responsibilities of the various parties who have a role to play in the STS problem. The parties involved are, in order: (i) the Minister of Transport, Public Works and Water Management who is responsible for policy, (ii) ProRail who is responsible for managing the railway infrastructure and traffic control, (iii) the operators who use the track and (iv) the Transport and Water Management Inspectorate (IVW), who ensures compliance with the rules.

Figure 4 shows the various parties, including the documents with the most important agreements between the various parties.

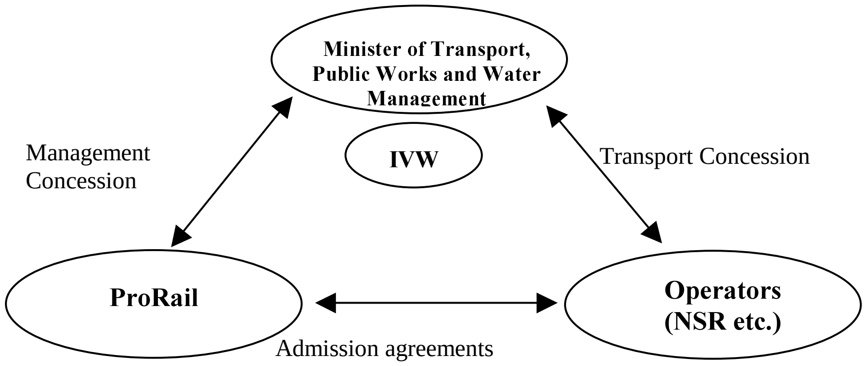


Figure 4: Relevant parties involved in the STS problem

In order to permit an analysis of the responsibilities between the parties outlined above, a number of documents are relevant:

1. 1875 Railways Act
2. Rail Safety Framework Document
3. Management Concession (from Ministry of Transport, Public Works and Water Management to ProRail) and Transport Concessions (from Ministry of Transport, Public Works and Water Management to NSR/other operators)
4. Safety certificates (from IVW to operators)

Re 1. In the 1875 Railways Act, the general rules are laid down for use of the railways.

Re 2. The Rail Safety Framework Document provides a vision of central government in respect of safety of rail transport in the Netherlands. A differentiation is made between the Framework Document on Rail Safety from 1999 and 2004.

Re 3. In order to permit management activities, a Management Concession is issued by the Minister to ProRail (awarded in 2004). To be allowed to use the railway network, a Transport Concession is issued by the Minister to operators (NSR, etc.).

Re 4. On the basis of audits carried out by IVW, since 1996, safety certificates have been issued by the Minister to operators, offering access to the track system.

Figure 5 shows a timeline, indicating the moment from which the most relevant legislation, policy documents, concessions and issued safety certificates apply. The vertical axis above the timeline shows the number of tasks with the various parties involved, whilst below the timeline, a framework is indicated, within which the railway sector operates.

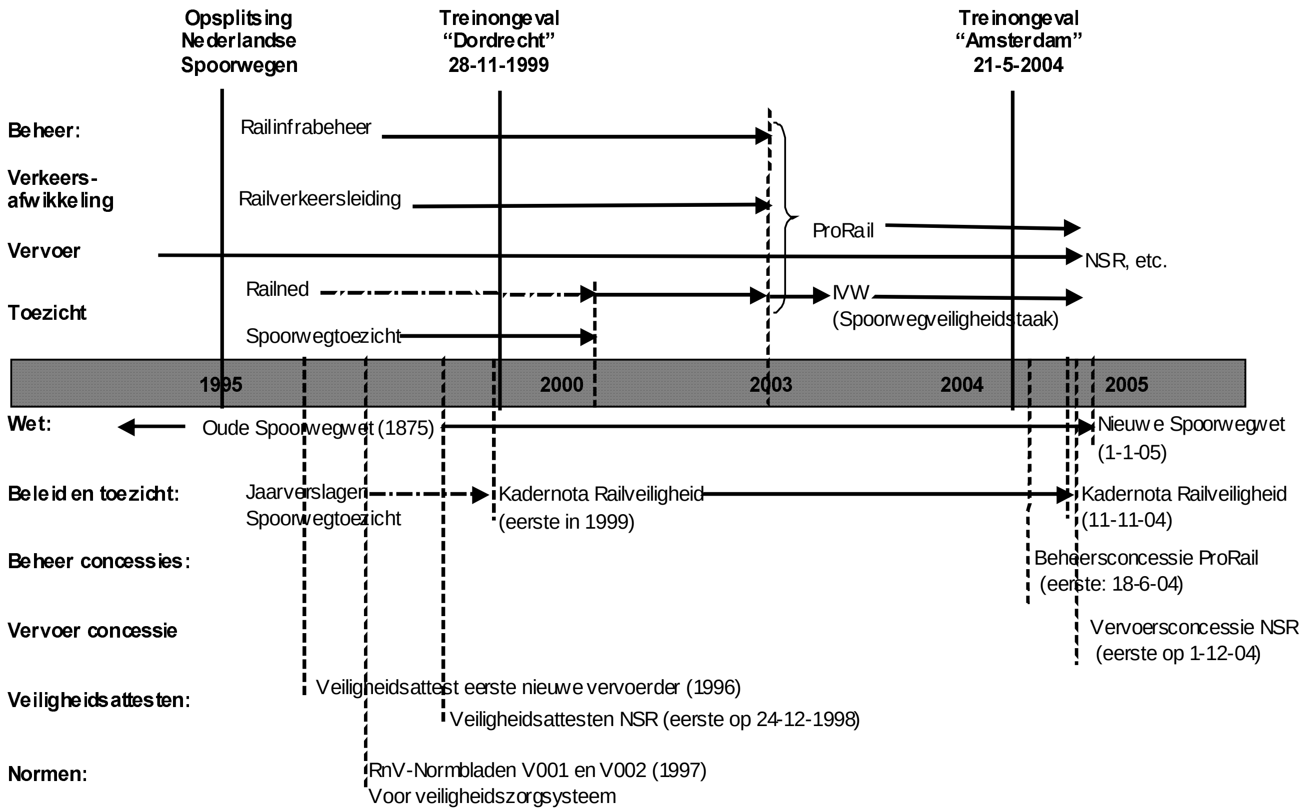


Figure 5: Timeline showing relevant parties and relevant documentation

Paragraphs 3.1 to 3.4 describe briefly the responsibilities and roles, respectively, of these parties. Because a new Act has been introduced since the accident in Amsterdam, the majority of relevant changes have been included in paragraph 3.5. Paragraph 3.5 also contains a brief summary.

3.1. MINISTER OF TRANSPORT, PUBLIC WORKS AND WATER MANAGEMENT

The Minister of Transport, Public Works and Water Management bears system responsibility for drawing up the railway safety policy and the resultant standards set.

In respect of the role of Central Government in railways safety, it is stated in the Framework Document 1999:

> *"The Minister of Transport, Public Works and Water Management is responsible for rail safety policy and the resultant standards set. Elaboration of this policy is primarily the responsibility of the sector itself: all companies and organisations participating in the railway system, have a contribution to make."*

In the (new) Framework Document for 2004, the roles of central government are further elaborated, and expressed as follows:

> *"Central government has a number of specific roles in the railway sector:*
> - *strategic policy maker and legislator;*
> - *shareholder in ProRail and NS;*
> - *financier for new construction and management;*
> - *concession granting body for the management of the rail infrastructure and for passenger transport;*
> - *the role of supervisor."*

In the framework Document for 2004, it is also stated:

> *"Within the frameworks and parameters set down, the responsibility for safe daily operation of rail transport lies with the companies involved, themselves."*

Requirements in respect of operators

In respect of the sharing of responsibility for safety between the Minister of Transport, Public Works and Water Management and the operators, the following is stated in the Framework Document for 1999:

> *"The frameworks and standards imposed by the Ministry of Transport, Public Works and Water Management on safety for rail traffic have been developed in close collaboration with the operating companies and organisations involved. Within the frameworks and standards laid down, the transport companies are responsible for the safe implementation of rail travel".*

In the 1875 Railways Act, a duty of reporting irregularities and incidents was already laid down. Underlying features of the 1875 Railways Act were a large number of safety regulations approved by the Minister (braking tables, structural clearance, etc.). The 1875 Railways Act also contained general liability for the causing of damage.

Requirements in respect of the manager

In order to meet the responsibilities of the Minister as concession-awarding party for the management of the railway infrastructure, a Management concession was granted by the Minister to ProRail, for the management of the main railway infrastructure in the Netherlands. In the '*General explanation of the management concession'*, the following is stated in this connection:

> *"The fact that the Minister is required to approve the management plan offers the possibility of 'constantly raising the standard to be achieved'".*

3.2. PRORAIL

The Minister of Transport, Public Works and Water Management granted a management concession to ProRail, as an expert rail infrastructure manager, for the management of the main railway infrastructure in the Netherlands. Management is for example taken to include ensuring the quality, reliability and availability of the main railway infrastructure. The related obligations were not formally laid down, until the end of 2004. With this formal laying down process, the obligations upon ProRail did become transparent, but in fundamental terms, the situation was not different from before their laying down. For this reason, the new obligations, in material terms, also apply to the situation before the end of 2004.

Duty of care

ProRail is responsible for the effective and efficient implementation of this Management Concession. In respect of the duty of care of ProRail, it is stated in article 3 of the Management Concession that:

> *"b. the main railway infrastructure can be operated safely and effectively, without excessive wear to railway vehicles;*
>
> *c. the risks of use and management for the safety of the main railway infrastructure are analysed, and suitable measures are taken, including as necessary the removal from service of part of the main railway, in order to sufficiently manage these risks, whilst taking account of the specific requirements of expected business operation, and the current state of technology".*

Management Concession
In accordance with the Management Concession, ProRail draws up a Management Plan, which must be approved by the Minister, and on the basis of which the Minister grants a subsidy. One component of the Management Plan is a description of the way in which ProRail fulfils the duty of care described above, and a description is provided of the measures to be taken by ProRail during the next subsidy period, on the basis of safety regulations and the government policy based on those regulations. In respect of implementation of the Management Plan, the following is stated in the Management Concession:

> *"Article 4: paragraph 5. ProRail will implement this concession, taking account of the components of the Management Plan, as approved by the Minister".*

In respect of the operation of a safety management system, the following is specified in the Management Concession:

> *"Article 7: paragraph 1. ProRail operates an adequate safety management system."*

Finally, the following is stated in the Management Concession about auditing:

> *"Article 19: paragraph 3. At the request of the Minister, ProRail will undertake an audit into implementation of this concession, or ProRail will collaborate with any audit to be undertaken into the implementation of this concession by a third party, on behalf of the Minister. The Minister will determine the scale, nature and scope of the audit, following consultation with ProRail."*

Rail Traffic Control
Rail Traffic Control, part of ProRail, is primarily responsible for the safe handling of rail traffic on the Dutch railways. Rail Traffic Control sets routes for trains, takes measures in the event of disruptions, coordinates all rail companies involved in disasters, and if necessary, adjusts the timetable. The train traffic controllers responsible for operational implementation are part of Rail Traffic Control. The primary task of Rail Traffic Control is to provide safe routes to operators.

3.3. OPERATORS

Operators are only allowed to use the Dutch railway system following the awarding of a licence by the Minister. Since the splitting up of the railway company in 1995, any (new) operator must have a licence. In addition, the operator must have a safety certificate. This safety certificate is granted by the Minister following an inspection, if the safety conditions are met. One of the those safety conditions relates to operating a safety management system. In the Framework Document for 1999, a description is provided of the content of a certificate:

> *"For business operation, the requirement is imposed that the operator must have a safety management system, all components and regulations of which are demonstrably present in the company, and structurally included in business operation."*

Safety certificate
In 1996, Railned (today the IVW), in advance of subsequent legislation, granted the first safety certificates to operators, on the basis of an assessment of the safety management system, guaranteeing that the operator does accept responsibility for 'continuous improvement of the level of safety'.
For the assessment of the operators by Railned, V001 and V002 standard sheets were used, which represent a specification of a safety management system. These standard sheets were developed by Railned. If the operators received a positive assessment according to these standard sheets, a safety certificate was granted[8]. The first safety certificate was awarded to NSR, in 1998.

The safety management system is described as follows, in the 1999 Framework Document:

[8] The following operators are admitted to the Dutch railway network: ACTS Nederland, BAM Rail BV, B-Cargo (NMBS), DB Regio NRW, Dillen & Le Jeune Cargo, ERS Railways, Eurailscout Inspection & Analysis, Häfen und Güterverkehr Köln AG (HGK), NoordNed Personenvervoer, NedTrain, NedTrain Consulting, NS Reizigers, Prignitzer Eisenbahn, Rail4Chem Benelux, Rail4Chem EmbH, Railion Nederland, Rotterdam Rail Feeding B.V., Strukton Railinfra Materieel, Syntus, Thalys Nederland, Volker Stevin Rail & Traffic, Zuid-Limburgse Stoomtrein Mij. Operators wishing to carry passengers or goods by rail can request capacity, from ProRail.

"The purpose of a safety management system is to continue guaranteeing safety, in the future. The safety management system must not be viewed as an assessment tool for the supervisor – even though it can be used as such – but far more as a quality tool for the operator himself, or for the infrastructure manager and traffic control. A safety management system describes the safety objectives aimed for (safety philosophy) and provides a picture of the organisation structure, with the safety tasks and responsibilities. In addition, the business processes are described, including the process of permanent auditing and safety improvement."

3.4. TRANSPORT AND WATER MANAGEMENT INSPECTORATE

The Rail division of the Transport and Water Management Inspectorate (IVW) assesses whether companies in the railway sector comply with the rules imposed. A special division is responsible for investigation into accidents and incidents. In addition, the IVW formulates the functional specifications for rolling stock and the railway infrastructure. In the '*General notes to the Management Concession'* the following is stated in respect of the supervisory task:

> *"The following are charged with supervision of compliance with this concession: the persons to be appointed by the Minister: a number of officials of the Directorate General for Passenger Transport of the Ministry (general 'concession management'), and of the Transport and Water Management Inspectorate (safety)"*

3.5. DEVELOPMENTS SINCE "AMSTERDAM"

Before 1 January 2005, the 1875 Railways Act was in force. Since 1 January 2005, almost the entire new Railways Act, dated 23 April 2004, has been effective.

In this new Railways Act, aspects have also been included which were already described in the Framework Document, for example in respect of the granting of a safety certificate, and operating a safety management system.

In respect of the operators, the Minister imposes requirements for permission to use the railway infrastructure. Article 32 of the new Railways Act states as follows:

"Our Minister will issue a safety certificate on request to the holder of or applicant for a business operating licence, if this party is able to demonstrate:

a. in the intended use of the railways, the ability to comply with the regulations laid down in or according to this chapter, and

b. through operation of an adequate safety management system, the ability to make safe use of the railways".

In respect of operating a safety management system amongst operators, the new Railways Act article 33 (dated 1-1-2005) states the following:

"Article 2. The certificate holder operates an adequate safety management system, on the basis of which it is guaranteed that the railway company:

a. in normal business operation and in foreseeable deviations therefrom causes no damage and neither unnecessarily hinders nor places at risk any other person, and ensures that railway traffic can be handled as far as possible, without disruptions;

b. takes account of the specific requirements if normal business operation interacts with that of other users of the railway, or of the manager;

c. recognises risks relating to business operation, and takes suitable measures to manage those risks sufficiently, taking account of the current state of technology and the knowledge and guidelines applicable within the sector, for safe business operation;

d. lays down and operates procedures for taking corrective measures in the event of deviations and incidents, and for continuously improving the level of safety, with a view to changing circumstances and on the basis of experience acquired;

e. ensures that employees with a safety position, with a view to maintaining their suitability, knowledge and professional capacity for the position in question …"

3.6. RESPONSIBILITIES

Responsibilities in the railway sector are allocated as follows:

- The **Minister of Transport, Public Works and Water Management** is responsible for drawing up railway safety policy and the resultant standards set.

- **ProRail** is responsible for the management of the railway infrastructure and traffic control, such that the infrastructure can be travelled safely. This management task should also be taken to mean assuring quality, reliability and availability of the main railway infrastructure in the Netherlands.

- **Operators** are only able to use the track if following assessment of the safety management system, a so-called safety certificate has been granted by the Minister.

- The **Rail division** of the Transport and Water Management Inspectorate (IVW), formerly Railned, is tasked with carrying out inspections at ProRail and the operators, to determine whether the rules laid down by the Minister are complied with.

In current regulations, but also in regulations post-1995 (split-up of NS), it is stated that the principle must continue to apply within ProRail and the operators, that measures with a positive effect on safety should certainly not be ignored (ALARP).

Since 1 January 2005, the aspects described above have been included in the new Railways Act, which became effective on 1 January. In the analysis in chapter 5, the circumstances at the time of and prior to the accident in Amsterdam on 21-5-2004 are assumed.

4. SEVERE INCREASE IN NUMBER OF STS PASSAGES

The accident in Amsterdam, whereby a signal at red was passed, cannot be viewed in isolation. The number of 'red light' passages has risen to a disturbing degree, over the last few years. The Council believes that as a result, an unacceptable situation has arisen on the Dutch railway network, whereby rail safety is under pressure.

The immediate cause of the accident on 21 May 2004 in Amsterdam was the fact that the driver of the empty double decker train passed a signal at red at the end of the platform. The fact that in Amsterdam a 'red' signal, or Stop Signal (STS) was passed is not a unique occurrence.

Increased number of STS passages
The number of times a year that an STS is passed on the Dutch railways is registered. The number of STS passages per year for the period 1988 – 2004 is shown in figure 6.

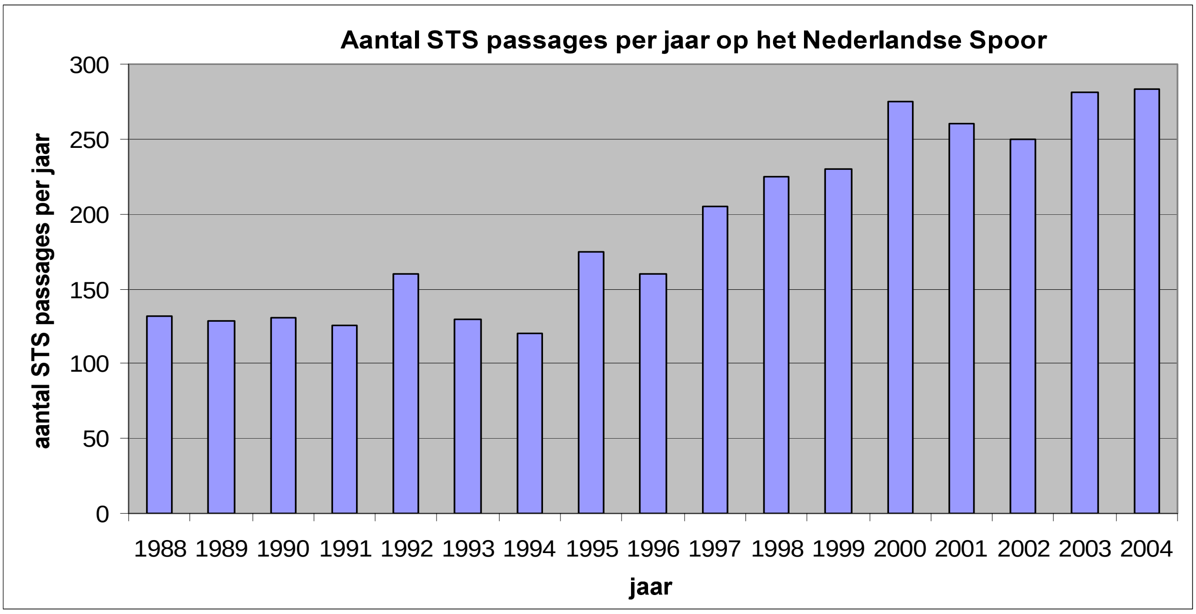


Figure 6: Number of red light passages (STS passages) on the Dutch railways in the period 1988 – 2004 [source IVW and RvTV study of Stop Signals by Railned, dated. 28-5-2001].

It may be concluded from figure 6 that a clearly upward trend is visible in the number of STS passages per year, whereby it is most notable that an alarming increase in the number of STS passages has emerged, since 1996. Over the last 7 years, the number of STS passages has almost doubled, whilst the number of train kilometres travelled[9] has risen by only 10 percent, over the same period.

STS passage as a potential risk
The passing of a stop signal does not always lead to an accident, but does engender a potential risk; STS passages can lead to (serious) collisions between trains. The examples of recent collisions as a result of passing an STS, listed below, and already reported by the Council to the Lower Chamber of the Dutch Parliament in a letter (dated 27 May 2004) provide some indication of the potential risk and serious possible consequences of red light passages (for an analysis of these accidents, see appendix 1)[10].

[9] The number of train kilometres in relation to the length of the network is an objective yardstick for traffic intensity on the railway network.
[10] The accident in Apeldoorn on 30-4-2003 is not included in this list. Although this situation did involve the braking distance (control of speed), it was not an STS passage.

- *21-5-2001 Zwolle. Flanking collision between a passenger train and a goods train. Senior conductor broken arm and seven passengers slightly injured. Severe damage to stock and infrastructure.*
- *8-6-2001 Amsterdam CS. Head-on collision between train and goods train. Material damage.*
- *13-6-2001 Utrecht CS. Flanking collision between two passenger trains. One seriously injured and two slightly injured passengers. Major damage to stock and infrastructure.*
- *27-11-2001 Amsterdam CS. Collision between an empty passenger train and a goods train. Severe damage to stock and the infrastructure.*
- *3-1-2002 Groningen. Flanking collision between a shunting unit and a passenger train. The passenger train derailed with two bogies and shunting unit with one bogie. Severe damage to stock and infrastructure.*
- *26-6-2002 Amersfoort. Flanking collision between passenger train and a new passenger train during a test run. Both trains partially derailed. One passenger and senior conductor slightly injured. Severe damage to stock and the infrastructure.*
- *16-9-2002 Rotterdam. Flanking collision between a shunting unit and a passenger train. Damage to stock and some damage to the infrastructure.*
- *10-10-2002 Utrecht. Flanking collision between an empty passenger train and a goods train. The passenger stock derailed as a result of the collision, with the front two bogies. Considerable damage to stock and infrastructure.*
- *20-3-2003 Roermond. Head-on collision between passenger train and goods train. First section of the passenger train completely crumpled. Driver killed. Fifteen (severely) injured passengers.*
- *17-6-2003 Utrecht. Collision between a passenger train and stationary train. Material damage.*
- *2-4-2004 Amersfoort. Head-on collision between a passenger train and a shunting unit. Damage to stock. Slight damage to the infrastructure.*

This list of STS accidents has now grown:

- *21-5- 2004 Amsterdam. Head-on collision between intercity train and double decker train. 19 injured and considerable stock damage.*
- *30-9- 2004 Roosendaal. Collision between intercity train and a Belgian goods locomotive, leading to more than 40 inured*
- *11-2-2005 Rotterdam. Sideways collision between two passenger trains. Result is considerable damage to stock and infrastructure.*

To permit an assessment of the STS problem, and to make it possible to estimate the extent to which the risks on the railways have changed over the years, two developments are relevant. Firstly, current developments in the railway sector have led to the design of double decker trains, which make it possible to carry more than 1000 passengers at a time. Secondly, the objective is to travel at ever higher speeds (up to 160 km/h).

To date, the passing of an STS has led to one fatality, and severe damage to stock and infrastructure. However, STS passages engender such a potential hazard, that large numbers of fatalities are a clear possibility.

5. ANALYSIS

In the investigation by the Council into "Amsterdam", no investigation was carried out into the specific circumstances which may have contributed to the missing of this red signal by the driver (confusion, visibility of signal, distraction, etc.). In the investigation, the Council did focus on the factors and measures which are generally intended to prevent or limit STS passages, and the related responsibilities.

This chapter contains an analysis of three relevant aspects in respect of the STS problem:

1. The technical measures which can prevent STS passages,
2. The influence of subroutes in passing an STS,
3. The taking up of responsibilities of those involved in the STS problem.

5.1. ANALYSIS OF TECHNICAL MEASURES FOR STS PASSAGES

The STS problem can be structurally solved by equipping trains with continuous automatic speed control. Using this system, an STS passage is made practically impossible. The Minister is currently investigating solutions for the STS problem.

According to the general safety principle in the railway sector, technical measures to prevent STS passages are always preferable. In this paragraph, the technical measures aimed at preventing an STS passage and the latest developments in that field are further analysed.

All modern train traffic control systems are based on the principle of continuous automatic speed control. This means that the speed of the train is constantly controlled from the point of departure, and a determination is made as to whether the speed is low enough, with the available brake capacity, and the remaining braking distance, to slow to stationary before the red light. As soon as the speed of the train threatens to rise too high, the red area in fig. 7, automatic braking is immediately initiated, down to a suitable speed in the given situation.

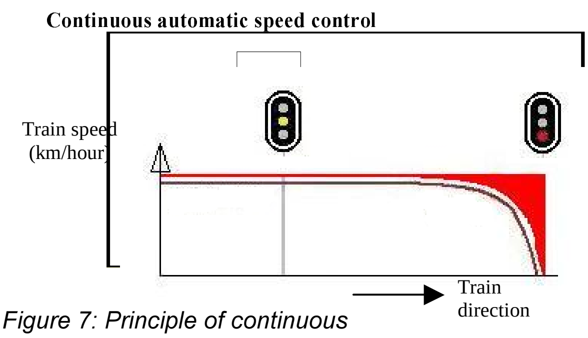


Figure 7: Principle of continuous automatic speed control

5.1.1. Development and limitations of the current ATB system

Until 1962, safe travel on the Dutch railway network was based solely on the 'red light discipline' of drivers; the drivers strictly complied with the instructions issued by signals. A very serious collision between two trains in Harmelen in 1962, leading to 92 fatalities and many severe injuries brought about a change in this situation. The then Railways Accident Board advised the Minister of Transport, Public Works and Water Management, as a result of this accident, to equip the Dutch network, with an Automatic Train traffic control system (ATB system). The ATB system is intended as a technical catch net for the passing of red signals, by trains.

The function of the ATB system is to check **whether** a driver is responding to signals alongside the track.

If the driver **fails entirely** to respond to the given order, the system automatically intervenes by activating emergency braking.

However, the ATB system suffers at least two limitations. Firstly, the system does not check whether the train has been braked sufficiently in order to slow to stationary before the red light.
A second important limitation of the ATB system is the fact that the system does not operate at speeds below 40 km/hours.

ATB First Generation

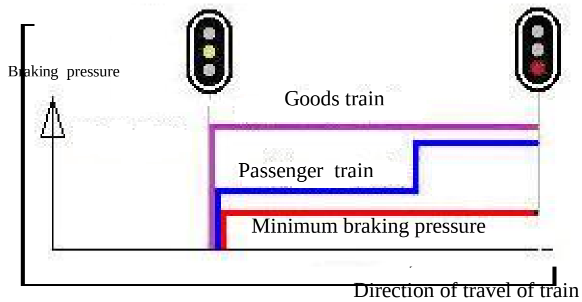


*Figure 8: **Additional explanation of operation of ATB First Generation**: As soon as braking is required, the ATB system checks **whether** the train is actually braked (the red level that indicates a minimum braking pressure). This is not sufficient to ensure that the train slows to stationary before the next red signal. In order to slow to stationary in time, a goods train must immediately apply full braking (purple line; more braking pressure). A passenger train is able to first brake cautiously (left section blue line: slight braking pressure) and brake sharply shortly before the red signal (right section blue line; considerable braking pressure) in order to slow to stationary in time before the red light.*

Statement by Minister in respect of development and implementation of ATB New Generation
The limitations of the ATB system at low speeds have however slowly been placed in a different light. An accident in Eindhoven in 1992 in part brought about this change.

On 31 October 1992, a collision took place between two trains in Eindhoven. The Railways Accident Board launched an investigation as a consequence, and in July 1993 issued a report of this investigation. The investigation indicated that the immediate cause was that one of the drivers had missed an STS. The most important conclusion of the Railways Accident Board at the time was that the ATB system was out of date. It also emerged that through the introduction of an ATB system New Generation, the most important limitations of the current ATB system (First Generation) could be solved. Situations such as that in “Eindhoven” would become a thing of the past, with the new system.

Following this accident, a public hearing was held (on 3 March 1993) whereby representatives of the management of the Netherlands Railways stated that the development of a new Dutch ATB system, ATB New Generation, would be concluded in the near future, and that they expected the urgent introduction of the system on the entire railway network in the Netherlands[11]. With ATB New Generation, equipped with continuous automatic speed control, the STS problem would be solved.

5.1.2. Technical solutions for the STS problem

Given the increasing importance of the unhindered crossing of borders, at the initiative and partly at the expense of the European Union, a development was initiated focused on a standard European control system based on modern computer technology, the so-called ETCS system[12]. Because this system is also equipped with continuous automatic speed control, the unwanted passing of red signals is impossible, and it is further possible to standardise control installations within Europe. The European developments, however, have influenced the developments of ATB New Generation.

Just like the current ATB system, ATB New Generation was to be a control system only for use in the Netherlands. Although ATB New Generation offers a level of safety comparable to that of ETCS, this system consists of other components. This system is therefore not suitable for railway lines on which foreign trains also travel. ATB New Generation would therefore only offer a control system suitable for railway tracks without cross-border transport.

[11] Given the Rail 21 plan, this was a logical development.
[12] ETCS: European Train traffic Control System.

Through the development of the ETCS system, the introduction of the Dutch ATB New Generation has been delayed, in advance of the European standard, and in the nineteen nineties was eventually put on the back burner, without any transparent decision.

5.1.3. "Dordrecht" recommendation on control system

More than 7 years after "Eindhoven", on 28 November 1999, two passenger trains were involved in a collision with one another in Dordrecht. The investigation by the Council for Transport Safety indicated that as in the case of "Eindhoven", one of the two trains had gone through a red signal. The investigation confirmed the conclusions following "Eindhoven": the ATB system is out of date and non-compliant. The Council issued the following recommendation in its report (May 2001) as a result of **"Dordrecht"**:

> ***The Council recommends the Minister of Transport, Public Works and Water Management to issue a clear statement on the phasing in which the Dutch railway network will be equipped with a modern ATB system, based on computer technology. Preventing collisions with derailed opposing trains should thereby be included in the schedule of requirements.***

In response to this recommendation, the Minister of Transport, Public Works and Water Management informed the Council by letter dated 28 April 2003 in respect of replacement of the current ATB system:

> *"…….It can be concluded from this that replacement will not take place only on the basis of safety considerations. Given the current situation on the railways and the state of maintenance, no stone will be left unturned in offering operators a sound infrastructure. In arriving at this situation (the house-in-order model), the gradual introduction of new protection and control systems is one part. Given the costs involved in replacement (several billion euros if introduced across the whole of the Netherlands) and the minimal advantages for safety, other decisive arguments will have to be put forward, such as quality improvement, capacity management and interoperability. …… In summary, therefore, I can inform you that work is being carried out in the spirit of the recommendations, but that we* ***cannot issue any concrete plans*** *within the time frame you suggest".*

5.1.4. Activities in respect of STS problem

In 2002, the rail sector itself first set up a working group for the STS problem. Following the disturbing rise in the number of STS passages, at the initiative of the Ministry of Transport, Public Works and Water Management, an STS working group was also established in January 2004, in which IVW, ProRail, operating companies and the Ministry itself are represented. The STS working group is currently investigating the possibilities for reducing the number of red light passages in the short term, and limiting the consequences of these STS passages. The Council, in its investigation into the accident in Amsterdam, took note of the activities of the STS working group, including the group's inventory of technical solutions aimed at reducing the number of STS passages.

New technical measures investigated by STS working group

The STS working group has been instructed to investigate all technical and non-technical possibilities. In terms of technology, three solutions have been investigated, namely (i) expansion of ATB functions (code 147), (ii) red light detection with GSM system and (iii) the ATB++ (ATB-plus-plus) system.

For the time being, the STS working group has opted for the ATB ++ concept, which concerns a functional expansion of the current ATB system. This latter already outdated system is also a continuous system, whereby the signal indication of the last passed signal is constantly known in the train cabin. With ATB++, we have reverted to the old, primitive concept of "points" protection. The first mechanical system based on this principle dates back to the year 1900. ATB ++ is a modern electronic version of this system. The principle means that a signal emitter is mounted in the track, at braking distance before the signal. This signal emitter issues a signal to a passing train to stop, if the signal is at red. All trains able to use the track in question are equipped with a device which can cause the train to stop. The Netherlands Railways objected strenuously to an ATB system based on a "points" approach, following the accident in Harmelen (1962), because for a number of reasons, such a system offers insufficient security. For this reason, the decision was then taken to opt for the ATB First Generation, a continuous system.

The ATB++ system is a Dutch addition to the ATB First Generation. In the selected points of departure, two (instead of one) signal emitters are mounted in the track. One at braking distance and one immediately before the signal. Two signal emitters offer far more possibilities for the timetable than a single signal emitter. The first signal emitter should be positioned at braking distance before the signal. At various braking distances, such as for passenger and goods trains, different signal emitters will be required. ATB++ is specifically Dutch, because the signal emitter (which works according to radio waves), with a view to cost reduction, does not follow the frequencies and coding of the European standard (ETCS). Immediately following the accident in Amsterdam (on 21 May 2004), the Minister of Transport, Public Works and Water Management made € 40 million available. According to the STS working group, for this amount, approx. 1000 signals can be equipped with ATB ++. Although this relates to only a limited proportion of the operable signals, those are the signals which represent the greatest risk of accidents in the event of an STS passage.
The Council shares the opinion of this working group that these measures will contribute to reducing the number of STS passages. The technical solution as presented to the Council by the working group will above all prevent the unknowing passing of and continuing to drive after a red signal. Alongside for example sliding a number of metres having passed through a red signal, this situation represents a proportion of STS passages. The working group is aiming for the rapid introduction of this system, after practical trials at 2 locations, and without extensive formal certification.

The proposed technical measures will reduce the number of STS passages. The STS working group believes in fact that the number could be reduced by 20%, thus reducing by 80% the risk, because this facility will be installed at the most hazardous locations. However, whatever the case, it remains a fact that STS passages engender a potential serious safety shortcoming[13].The only possibility of fully solving the STS problem is to equip all trains with a control system based on continuous automatic speed control, which for example is a component of the ETCS system or ATB New Generation.

5.2. ANALYSIS OF SUBROUTES AND STS PASSAGES

The introduction in 1995 of the VPT system was essential to raise train frequencies. This increase in train frequencies has resulted in more subroutes being set. The problem of subroutes is that offering a relatively short route does often not match the expectation pattern of the driver. This has a negative effect on the number of STS passages. The Council, in its "Dordrecht" report, recommended a cautious approach in setting subroutes. By using the VPT system, the use of such subroutes has in fact only increased.

5.2.1. General

There has long been a suspicion that there was a certain relationship between the introduction of the VPT (Transport by Train) system and STS passages. This was reason for the Council to investigate the use of the VPT system. The description of the method of the VPT system, necessary in order to determine the effect, is a large part of this paragraph.
The VPT system, together with the control system (the signals in combination with ATB First Generation) forms the core of the railway system. The VPT system is responsible for continuous flow of railway traffic, whilst the control system is aimed at preventing trains colliding.

Using the control system, a route is set for every train. A check is then carried out as to whether that route is free and whether the points are at the right setting. If all safety conditions are met, the signals are switched to safe, and the route can actually be used. The striving is to set a route from platform track via open track to arrival platform, so that trains need not halt en route. As train frequencies increase, this point of departure comes under pressure. Above all if disruptions occur. The most obvious solution in the case of disruptions is to set short sections of route or subroutes. The use of the VPT system, the task of which is to promote continuous flow, has led to an increase in the use of subroutes. Subroutes whereby the driver is required to once again stop shortly after departure, such

[13] See photographs appendix 1.

as that set at “Amsterdam” (see circumstances) are however routes with relatively large risks attached, because they often do not tie in with the expectation pattern of the driver. The use of subroutes was considered so risky within the old Netherlands Railways, that such routes were only permitted to be used under exceptional circumstances.

Having determined that the use of subroutes has risen considerably over the last few years, the Council once again looked through the list of STS collisions which have occurred since “Dordrecht”. It emerges that 14 serious STS collisions have taken place.

Of these 14 accidents, 4 were accidents whereby the setting of the route played no role. These are: Amsterdam (8 June 2001), Groningen (3 January 2002), Utrecht (10 October 2002) and Amersfoort (2 April 2004). In these accidents, the trains departed whilst such a departure was not permitted. In 9 of the 14 STS collisions, subroutes were in use (see appendix 1)[14]. After the accident in Dordrecht in 1999, until the year 2004, more than 1300 STS passages have occurred (see figure 6).

Of these 14 collisions, precise details are known of the circumstances in which they took place. For the STS passages which have not resulted in a collision, far less is known. Because not all subroutes result in a collision, but because it is known that of the 14 STS passages which did result in serious collisions, more than half involved the setting of a subroute, it seems very likely that in far more of the in total approx. 1300 STS passages in the period 1999 – 2004, subroutes played a role.

5.2.2. Current situation deviates from old plans

In 1988, the Netherlands Railways launched a plan, known as ‘*Rail 21, on track for a new century*’ (June 1988), aimed at raising rail transport to a higher plane. The Netherlands Railways made society an offer: in 20 years time twice as many passengers with 1.5 times as many trains. The precondition was that the government would take responsibility for the necessary expansion of the railway infrastructure (costs estimated at € 8 billion). Broadly speaking, ‘Rail 21’ has in fact been implemented.

The proposed and subsequently implemented expansion of the infrastructure did not stand alone. For the existing railway infrastructure that in the future would be handling far more trains, two projects were initiated as far back as the nineteen eighties within the Netherlands Railways, aimed at ensuring the smooth running of more intensive train traffic. The ***first project*** concerned the development of the Transport By Train (VPT) system, the objective of which was to improve train punctuality in order to achieve optimum utilisation of the tracks. Briefly summarised, this means improving through-flow. The result is more trains travelling closer together.

The ***second project*** was the development and implementation of a new control system aimed at covering the increased risk arising through the use of the VPT system. The core of the new system was the ATB New Generation. This train traffic control system, equipped with continuous automatic speed control, offers almost total protection against STS passages, because the speed of the train is continuously monitored. In normal operation, with this system in use, STS passages cannot occur (see paragraph 5.1).

The point of departure employed by the Netherlands Railways and later by ProRail in respect of safety of railway traffic is simple. The railway infrastructure is such that conflicting routes are technically excluded. Within this point of departure, all possibilities offered by the infrastructure are permitted. The assumption thereby is however that drivers follow the instructions issued by signals. The technical possibilities of the systems employed do however have limits. With the specified point of departure that everything is permitted which is technically possible, a constant increase in train frequency automatically leads to a continuous reduction in safety margins.

The problem of ‘narrow margins’ as a result of which immediately unsafe situations could occur, was foreseen by the Netherlands Railways. Against this background, alongside the VPT system aimed at setting routes and ensuring maximum exploitation of the track, the ATB New Generation was developed, fitted with continuous automatic speed control. Unlike the ATB First Generation system, this system is able to correct driver errors, so that STS passages are prevented.

[14] In appendix 1, these 9 accidents are analysed.

The rapid development of European integration interfered with the plans relating to ATB New Generation. In the nineteen nineties, it became clear that ATB New Generation could not play a role on railway lines that form part of the European railway network. As a result, the further development and expansion of the ATB New Generation in the Netherlands was halted. As concerns the introduction of the new European system, developed on behalf of the European Union, the railway sector in the Netherlands took up a waiting attitude.

The railway network has not been equipped with an updated control system that covers the risks resulting from increased traffic intensity on the track. On the other hand, train frequencies have been raised.

5.2.3. Background information: the control concept of the VPT system

The VPT system, part of which is responsible for setting routes, was first employed at one station in 1994. Since that moment, the system has been gradually introduced. During the nineteen eighties, train traffic was regulated from 45 train traffic control posts (the buildings from which train traffic is directed by train traffic controllers). Communication between these posts was exclusively spoken, by telephone or by fax. If a particular train was too late, this was generally notified by telephone to the next post. This working method hindered punctuality of services, and imposed boundaries on the increase in train frequency. To arrive at improved punctuality and further growth, another working method became necessary.

Figure 9 Amsterdam Train traffic control post pre 1995. For each train, a route was set by hand. The advantage of this process was that in the event of disruptions, the train traffic controller could set any conceivable route. All this information was brought together on the panel in front of him. The train traffic controller saw the local problems on the panel, alongside all possibilities for solving those problems.

One of the three clusters which makes up the VPT system is the cluster VPT process control system. In the framework of the implementation of the VPT process control system, the decision was taken to reduce the number of train traffic control posts from 45 to 13, and to introduce electronic communication between these centres. As a result, it became possible for all posts to access simultaneously all necessary and desired information. It was another objective of the VPT process control system to reduce the number of routine and often monotonous, human actions necessary in operating the 'old control equipment" (see figure 9). In concrete terms, this meant the removal of the position assistant train traffic controller. Whereas in 1995, 120 train traffic controllers plus assistants were still actively employed, that number has now fallen to only 80. The costs for development and implementation were roughly € 150 million. In addition, for a further € 150 million, other logistic systems were developed, including planning systems. The first version of the VPT process control system was introduced as a trial, in 1994 in Eindhoven. Within eight years, practically the entire country had been fitted with this system. This process was almost entirely completed in 2002. Subsequently, two new versions were issued and implemented with new, additional possibilities and improvements based on experience. At present, work is once again underway on renewed versions of the system, for example for the new Betuwe line.

It is important to note that the control concept operated by the VPT process control system is fundamentally different from the concept used before 1995, when routes were manually set by the train traffic controller. Because the train traffic controller himself set the routes on an ad hoc basis, flexible responses were possible to the actual situation. Using the VPT system, routes are automatically set according to a fixed pattern. In this process, if everything runs smoothly, the train traffic controller has no task.
The initially selected point of departure in the construction of this VPT process control system, namely only full routes, at locations with intensive train traffic led to major delays. For this reason, by way of (logistic) improvement, a change was made to the VPT process control system, which made it

possible to set long routes in sections (so-called subroutes). This meant letting go the old philosophy:

only setting entire routes, an approach which was complied with until 1995. The problem of these subroutes is that offering a relatively short route often does not match the expectation pattern of the driver. The number of track situations whereby subroutes can be set is very considerable. However, subroutes are above all used in the event of disruptions in respect of the regular timetable. As a result, just like the disruptions themselves, they occur incidentally and at least for drivers at unpredictable moments and locations. These subroutes, which currently can be set automatically by the VPT system, and which in the situation before 1995 were avoided by the train traffic controller, play an important role in STS passages.

Before 1995, a route was manually set for every train. Then the train traffic controller with his assistant(s) could use all available routes at the station. They were able to respond directly to local disruptions, with routes that were the most suitable at that moment. They were also instructed, when setting routes, to exercise the necessary caution. The setting of subroutes for certain movements was viewed as risky, and was therefore only to be permitted in exceptional circumstances. Final responsibility for the setting of safe routes lay with the head of the train traffic control district in question. In some districts this was implemented in the form of formal rules, whilst in other districts there were only informal rules.

Before 1995, the train traffic controller was a specialist able to direct train traffic on an ad hoc basis at micro level, with resources that precisely matched the situation at that moment. As disruptions increased in the railway network, the train traffic controller was generally powerless, because he had no total overview. After 1995, the VPT process control system effectively took over this direct, local control.

The point of departure for VPT process control is the timetable. This point of departure is in fact identical to the old situation. The timetable is drawn up on the basis of the 'green wave' concept. All trains travel precisely on time. They stop only at the platforms in the stations where they are expected to stop. On the basis of this concept, it is determined what routes trains should follow at track complexes between platform tracks and on the open track (a section of track without points between stations or insertion points). According to the timetable, trains are therefore never stationary in the area between platform and open track (see figure 10). The work of the train traffic controller mainly takes place in the gridiron in the section between platform and open track. On the open track, control by a train traffic controller is not necessary. The train traffic controller therefore has no influence on this movement. Only when handling incidents does the train traffic controller play a role in these areas.

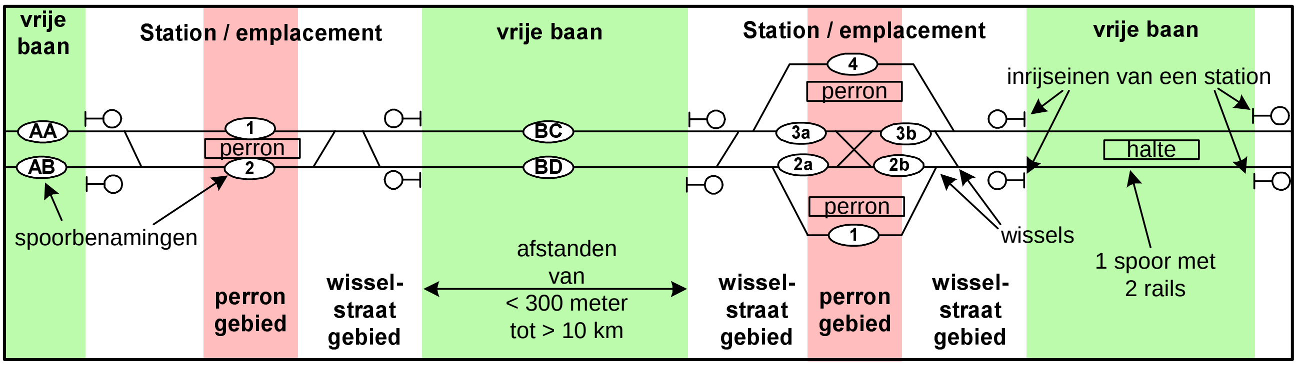


Figure 10: A simplified diagram of the railway network. The open track (green) is a section of track between two stations without points and with fully automatic protection. A station (red + white) has operable signals. The gridiron area (white) refers to the section between the platform tracks and the open track.

Before 1995, the (assistant) train traffic controller himself set the route on the basis of a written track sheet. He could deviate from this sheet if circumstances required. Post-1995, the VPT system sets the routes and as long as everything goes according to plan, and all information is available on time[15], the

[15] This was not the case in Amsterdam.

train traffic controller simply watches. In the VPT system, the focus has been placed on preventing problems by offering the train traffic controller an up to the moment updated timetable, in which the trains and routes are laid down. The attention of the train traffic controller is aimed primarily at processing train traffic with the routes offered by the VPT system.

5.2.4. The cause of the increased number of subroutes

The introduction of the VPT system has meant that the 'modern' train traffic controller is often responsible for more stations than pre-1995. His central task today is to ensure that train traffic is handled. It is important in that respect that the automatic system continues to operate as much as possible. The routes are automatically set as long as the trains report at the expected location within a margin around the planned time.

A station is intensively used throughout the day. It is precisely worked out in advance how trains should travel in order to make maximum use of the infrastructure. A preset pattern is employed. If trains arrive too early or too late, or in the event of disruptions, a problem arises in the current situation. The routes that have to be set for the too early or too late trains cross the routes of the trains travelling on time. If a train for example arrives more than 12 minutes too late, sections of the route for this train are by that time in use by other trains. The route for the train that is too late can then no longer be set in one go, by the VPT system. The method of solving this problem is for the train traffic controller to himself set the old route thought up by the VPT system, however now with an adjusted timing. The train traffic controller then leaves it to the VPT system to further control the old route. The VPT system does this by already setting the section of the route that is available. The result is a subroute.
The driver is required to respond alertly to this situation. The risk that the driver will miss the last signal in the subroute is considerable, in practical terms. An additional aspect is that in the modern version of the VPT system, subroutes are sometimes set fully automatically, without the intervention of the train traffic controller.

In addition, the setting of subroutes could be promoted by the way in which punctuality is measured at present. In current punctuality measurements, a determination is made of how many trains travel on time, by determining the number of trains that leave on time. This results in permanent pressure on departure times. Every opportunity to depart is then used, even if the train is forced to once again halt a few hundred metres further on, by a subroute. In the measurements, this train is still counted as having departed on time.

5.3. ANALYSIS OF RESPONSIBILITIES OF PARTIES INVOLVED

Society expects the parties involved to take their responsibility in respect of safety, whereby in a transparent manner, there is a constant striving for improvement. Despite the severe rise in the number of STS passages, in response to the recommendations following "Dordrecht" (2001), both the Minister, ProRail and the operators failed for a considerable time to take any effective measures for reducing these numbers, and various possibilities remain unused for reducing the number of STS passages.

In this paragraph, the responsibilities and tasks of those involved in the STS problem as described in chapter 3 are analysed. In order to be able to start analysing the responsibilities as taken, a historical overview is provided in paragraph 5.3.1 of the STS problem. Subsequently, on the one hand a picture is provided of the expectations of society on the taking of responsibilities by the parties involved, and on the other hand, how these responsibilities are actually taken in practice, with specific attention for the response of the parties involved to the recommendations following the “Dordrecht” investigation. Finally, background information is provided about the way in which the parties have acted in respect of safety, and in particular in respect of the STS problem.

5.3.1. Historical overview of STS problem

In this paragraph, a brief overview is provided of the history of the STS problem, and the way in which the parties involved have responded.

- In **1962**, two trains collided head on in Harmelen, as a result of the passing of an STS, with dreadful consequences. On the recommendation of the Railways Accident Board, the Dutch railways were equipped with Automatic Train traffic Control (ATB First Generation).
- In **1988**, the number of STS passages per year totalled approx. 130.
- In **1988**, the Netherlands Railways launched the plan ‘Rail 21’ (June 1988), that provided for a doubling of the number of passengers and an increase in train traffic of 50 percent. For the existing network, two systems were developed to allow higher train frequencies to be processed: (i) the VPT system facilitating an increase in the number of train frequencies and (ii) ATB New Generation (covering the increased risks at higher train frequencies).
- In **1992**, the Railways Accident Board concluded that the ATB system is out of date, following a serious accident in Eindhoven as a result of an STS passage.
- In **1993**, at a hearing following “Eindhoven”, the Netherlands Railways stated that they expected the urgent introduction of ATB New Generation.
- In **1995**, Rail Traffic Control started introducing the VPT system according to the plan ‘Rail21’.
- In **1996**, the number of STS passages per year totalled approx. 150.
- In **1997**, and subsequent years, the ETCS system was developed on a European scale. In the Netherlands, a waiting attitude was tacitly taken up in respect of this ETCS system, as a result of which the development of ATB New Generation was delayed and eventually put on the back burner.
- In **1998**, for the first time, NSR was issued a safety certificate by Railned, in which one of the objectives laid down was a reduction in the number of STS passages.
- In **2000**, the number of STS passages per year totalled approx. 260.
- In **2001**, the Council for Transport Safety, following an accident in Dordrecht in 1999, stated that the ATB system is out of date and requires urgent replacement. The Minister was recommended to indicate the phasing in which replacement would take place, and the operators were recommended to take measures which would reduce the number of STS passages in the immediate future.
- In **2002**, the operators responded to the recommendations from the Council following “Dordrecht”, stating they would be taking measures aimed at reducing the number of STS passages (see paragraph 5.3.3).
- In **2003**, the number of STS passages per year totalled approx. 260. By this time, 10 accidents had occurred, since the accident in Dordrecht, resulting from the passing of an STS.
- In **2003**, in response to the Dordrecht report, the Minister stated that ‘it is not possible to give’ any concrete planning for the replacement of ATB by an improved control system.
- In **2004**, the number of STS passages per year totalled approx. 280.

- In **2004**, the Minister established an STS working group, aimed at reducing the number of STS passages, in the immediate future.

- In **2004**, the STS working group issued a proposal according to which, for € 40 million, a reduction of 80% of risks could be achieved, with a reduction of 20% of the number of STS passages.

- In **2005**, the Minister wrote a letter to the Lower Chamber of the Dutch Parliament (dated 17-5-2005), taking up the proposal from the STS working group in respect of the reduction of the number of STS passages.

- **To date**, since the accident in Dordrecht, 14 accidents have occurred as a result of the passing of an STS.

5.3.2. Expectations of society in respect of safety

In respect of the responsibility of the companies involved, in the Framework Document 2004, the following is stated:

> *"Even given the European contribution, the Netherlands is in favour of a policy line aimed at standardising the requirement, and not the solution. The underlying idea is that the organisations themselves are often better capable of assessing which methods they should employ in order to achieve the required safety and sustainability. As a consequence, central government will standardise the safety levels which must at least be achieved, and which comply with international and European requirements. Within the frameworks and parameters of central government, the responsibility for safe, daily implementation of rail traffic lies with the companies involved, themselves."*

The Minister of Transport, Public Works and Water Management bears system responsibility for drawing up policy. The actual work for rail transport is carried out by ProRail and the operators. By awarding concessions, the Minister has entrusted responsibility for safety to the organisations involved. ProRail and the operators (NSR) are responsible for safety on the railways. Given the professionalism of ProRail and the operators, it goes without saying that these organisations bear their own responsibility in respect of ensuring safety.

In the Framework Document, it is specified that the railway business has an adequate safety management system, guaranteeing that the operator takes responsibility for 'continuous improvement of the level of safety'. Since 1996, safety certificates have been granted on the basis of an assessment of the safety management system, guaranteeing that the operator takes responsibility for 'continuous improvement of the level of safety'.

As stated in the Framework Document 2004, even if these objectives are achieved, the principle remains in place that measures with a positive effect on safety must certainly not be left unimplemented (ALARP principle, as low as reasonably practicable). However, also in the Framework Document for 1999, the even 'more stricter' term ALARA (as low as reasonably achievable) was employed: 'the striving to reduce the number of accidents resulting in injury, and determining where ALARA is possible'.

In summary, in the opinion of the Council, ProRail and the operators must put into practice their own responsibility for safety, by operating as safely as possible within the frameworks and possible safety limitations imposed by the Ministry of Transport, Public Works and Water Management, whereby they must continuously, creatively and demonstrably seek improvements in respect of safety.

5.3.3. Response of the parties involved to the "Dordrecht" recommendations

In 2001, the Council for Transport Safety issued a report following the accident in **Dordrecht** on 28 November 1999. In the report, the Council issued five recommendations, based on its investigation. In this paragraph, an analysis is given of the way in which the parties involved have responded to these recommendations:

> ***Recommendation 1:***
> *The Council for Transport Safety recommends the management of the transport companies involved (in particular NS Passengers, Railion) to formulate measures according to which the number of red light passages can be reduced in the immediate future. The Council therefore suggests having drivers report poorly visible signs, and pass on the results to Railinfrabeheer.*

The various operators issued the following responses to this recommendation:

- In a letter to the Council, NSR indicated that a confidential reporting point on railway safety has been established for drivers and conductors, at NSR. Via this reporting point, any identified safety problems can be reported, for example poorly visible signals. In addition, in 2001, NSR introduced the so-called vigilance test (method of analysing driving behaviour), according to which it is possible to determine whether the reassessment of drivers has to be adjusted. In 2002, an investigation was carried out into how re-instruction could be improved. A communication programme was started, to inform drivers and other persons involved of the occurrence and consequences of red light passages.
- In response to the recommendation from the Council, Railion indicated that it had started the ‘Responsible care’ campaign, in which the STS problem would be specifically dealt with.
- Thalys indicated that (i) a workshop has been attended on this subject, (ii) during regular re-instruction, drivers are instructed on signalling and STS passages, (iii) psychological examination of drivers is renewed, following STS passages, (iv) poorly visible signals are reported and (v) a ban has been introduced on the use of GSM telephones and the railpocket.

Although the recommendation was not addressed to the Minister, the Minister did respond by having Railned (now part of the Transport and Water Management Inspectorate - IVW) verify the investigation results of the Council. This verification was carried out urgently and after several months, the report appeared: “*The state of affairs”*. Because the investigation into the safety situation on the railways emerged as fulfilling a useful function, the investigation was repeated annually, from that moment onwards. The disturbing number of STS passages was repeatedly identified. Once this fact had been determined on three occasions, the Minister ordered the establishment of the STS working group described in chapter 5.1.4, and a steering committee, to deal with this problem.

The STS working group has developed a solution for the STS problem which, according to the group itself, will reduce the number of STS passages by 20%, and the STS risks (the seriousness of the consequences) by 80%. In a letter (dated 17-5-2005) to the Lower Chamber of the Dutch Parliament, the Minister took up this proposal.

Although the operators indicated, in response to the recommendations from “Dordrecht”, that they were making various efforts to reduce the number of STS passages, these efforts seemed to be having no direct effect. Indeed, the number of STS passages has continued to rise (see figure 6). Nonetheless, since the initiative by the Minister to establish the STS working group, within a number of months, a solution would appear to have been developed which, according to the working group, will be capable of preventing a large proportion of the number of STS passages.

The transport companies and ProRail could have noted, shortly after 1995, that the scale of the STS problem was increasing rapidly. This could have given grounds for drivers to analyse the circumstances in which they are required to work. Driving trains not only calls for professionalism but also the constant alteration and evaluation of the rules that indicate how to deal with the technology. These rules should make it possible to learn from mistakes and introduce improvements. If the parties involved believed that the STS problem could not be solved through their own resources, the operators and ProRail could have passed on this situation to the Minister. This did not happen.

On the basis of the above, the Council concludes that both ProRail and the operators, both of whom had or should have had an understanding of the number of STS passages, failed to sufficiently take their own responsibilities in respect of STS passages.

Recommendation 2:
The Council recommends the Minister of Transport, Public Works and Water Management to issue a clear statement on the phasing in which the Dutch Railway network will be equipped with a modern ATB system, based on computer technology. Preventing collisions with derailed opposing trains should thereby be included in the schedule or requirements.

The analysis of the response of the Minister of Transport, Public Works and Water Management to recommendation 2 from “Dordrecht” is described in paragraph 5.1.

Recommendation 3:
The Council recommends the management of Rail Traffic Control, until the moment of introduction of a new, modern ATB system, to set subroutes which are travelled at speeds of less than 40 kilometres per hour, and as a result effectively without ATB monitoring, with considerable caution. If subroutes do have to be set, the train traffic controller should maintain supervision. A reliable automatic report to the train traffic controller of a red light passage by a train is an essential tool in this respect.

Rail Traffic Control that today is part of ProRail, failed to provide any substantive response to this recommendation. And yet there was every reason to do so.

The introduction in 1995 of the Transport By Train system (VPT system) was necessary to increase train frequencies in accordance with the ‘Rail21’ plan launched by NS in 1988. The introduction of the system meant that more subroutes were set. The problem of subroutes is that offering a relatively short route is often not in line with the pattern of expectations of the driver. This has a negative effect on the number of STS passages. Instead of being ‘cautious’ in setting subroutes, through the use of the VPT system, the number of subroutes in fact has only increased. Operators have made use of these subroutes, without any criticism. No measures have been taken by the operators to manage this increased risk. Although operators must be aware of which aspects can negatively influence the driving behaviour of their drivers, there has been no communication with drivers about the changes arising from the introduction of the VPT system. In the opinion of the Council, the operators should have carried out an analysis into the number of subroutes being set. In addition, given the increased risk of subroutes for train safety, ProRail should have explicitly notified this risk to the operators.

Recommendation 4:
The Council recommends the management of Railinfrabeheer to harmonise the design process for rail infrastructure with the standard sheet for safety management systems of Railned, and to harmonise the designs with the current statutory rules.

ProRail responded to this recommendation by indicating that in 2003, Railinfrabeheer would be implementing a safety management system.

Recommendation 5:
The Council recommends the Minister of Transport, Public Works and Water Management to appoint a supervisory body also for the government-commissioned organisations.

The Minister responded to this recommendation by indicating that within the Ministry, a differentiation is made between policy directorates and IVW. Based on an analysis within IVW, it emerges that at present, IVW to a limited extent implements its supervisory role in respect of ProRail. IVW expects to carry out its first audit at ProRail, next year.

5.3.4. Taking of responsibilities in practice

It may be expected by society that the operators and ProRail will utilise all the possibilities open to them for improving safety. In the specific case of the STS problem, this means that specific actions could have been expected from the Minister, the operators, ProRail and IVW, with a view to preventing STS passages, in particular given that in the years since 1996, the number of STS passages rose considerably. Practice however, shows the opposite to be the case. The developments described below are just a few examples of evidence that (i) measures have been taken which have had a reasonably negative influence on the circumstances in which drivers are expected to operate, whilst the parties involved were aware, or at least should have been aware of the considerably increasing number of STS passages and (ii) only limited attention has been paid to safety by the parties involved.

No insight into the safety consequences of the introduction of GSM telephones
A driver has a safety-critical task with major responsibility. Trains today are able to carry more than 1000 passengers. As described in paragraph 5.1, the current safety system, the ATB system, does not cover all safety problems. As a consequence, safety on the track is still to a considerable extent dependent on the continuous alertness of the driver. If it is determined that the number of STS passages is rising, particular caution should be maintained in respect of changes which have an effect on the environment and the task implementation of the driver.

Several years ago, drivers of NS Passengers (the largest operator) were supplied with a GSM telephone device. Until the introduction of the GSM telephone, all communication with the driver took place exclusively via Telerail, a fixed telephone in the cabin. Only the train traffic controller who on his work panel could see where the train was located, could in the past contact a driver via this Telerail system. Through the break-up of NS, the operators could no longer communicate via the Telerail system, so that operators were forced to use a different means of communication. Every time a driver is called or himself makes a call via the GSM device, the driver is distracted.

Prior to the introduction of the GSM device, no analysis was carried out into the possible influence of this device on the driving behaviour and alertness of the driver whilst driving. In addition, the GSM provider records the time and duration of all calls. An analysis of calls made and received during the service shift of a driver is relatively simple, such that the risks of GSM use can be determined. To date, the operators have not yet carried out any such analysis.

Failure to investigate STS passages by operators
Until 1995, in accordance with the Railways Act, the operators carried out their own investigations into the passing of stop signals. After 1995, this task was taken up by Railned, and today is the responsibility of IVW.

According to the Railways Act, the intention is that immediately following an STS passage or other incident, an investigation be carried out into the circumstances in which the incident took place. Based on the analysis of these circumstances, it must be possible to determine whether there are possibilities to prevent a repetition. According to the rules of the Railways Act, this investigation must be carried out by the operating company of which the driver in question is part. Until 1995, this was the case. Since 1995, STS passages have primarily been investigated by Railned, and subsequently by IVW[16]. The conclusion of many of these investigations by IVW is that STS passages form a 'non-manageable factor'[17]. This is the message passed back to operating companies from IVW, once the investigation is concluded. For the operating companies, the IVW is the competent authority that plays an important role in issuing the required licences. In addition, IVW carries out audits and inspections within the transport operators. Such a statement from IVW that STS passages form a non-manageable factor will not encourage the transport operators to improve the situation.

Investigation of incidents and accidents is a fundamental component of the safety policy and management system. Thanks to the expertise available within the transport operators and the immediate access to background information, it is possible to rapidly and effectively determine the cause and underlying causes of STS passages. In this way, it is possible to determine whether the driver was for example distracted (environmental factors) or whether the driver wrongly estimated the braking distance (training aspect). The results of such investigations can be used for feedback to the drivers in question and to the organisation (for example: reducing distraction, need for additional training) in order to prevent repetitions. If, for example, from an internal investigation it emerges that a signal is poorly visible, and that this fact played a role in the STS passage, this could result in feedback to the network manager (ProRail). In this way, a structured improvement cycle for the level of safety could be established. By

[16] In these investigations, use is made of the SAMOS method, which is a railway-specific variant of the Tripod method.
[17] Once Railned became part of IVW, this approach was gradually dropped. The focus of accident investigation therefore became more distanced and more targeted at non-compliance with applicable rules.

placing the investigation task with IVW, there is less initiative for the operators to carry out the investigations. However, even if the investigation is carried out by the government (IVW), the operating companies themselves should investigate and evaluate their own incidents.

The training of drivers
In 1999, the number of STS passages had almost doubled as compared with the number in 1995 and previous years. 1999 was also the year in which new training requirements were introduced for drivers. The previous requirement that a driver had to have acquired 200 days practical experience before becoming fully qualified was reduced to 40 days, when the new training requirements were introduced.

Contrary to expectations, given the increased number of STS passages, the training requirements were therefore not tightened up, but considerably slackened. The Minister of Transport, Public Works and Water Management permitted this reduction of requirements. Based on their own responsibility for safe transport, the operators were expected to view the training requirements as a minimum, whereby if necessary they would impose their own additional requirements for their drivers. The Council has not investigated to what extent such measures have been taken.

Automatic Journey Registration (ARR)
At present, every train is equipped with an Automatic Journey Registration system (ARR system). This system records the driving behaviour of the driver in combination with the signals he comes across. Through the structured and periodic reading out of this system, the driving behaviour of drivers can be charted out. Using the ARR system, such driving styles can be analysed, offering the management an opportunity of receiving professional feedback about the driving behaviour of its drivers.

At present, almost no use is made by the operators of this possibility, which is available right now, and for which additional investments may be necessary, to ensure efficient use.

Simulators
Today, computer systems are available on the basis of which simulators can be easily built. The possibilities of simulators are unlimited. The intention of a simulator is to introduce a driver to the route he will be travelling, in advance, so for example that he is conversant with the locations of special signals along the route.
At this moment, simulators are used in the rail sector. RET[18] for example operates a simulator for training metro drivers. In Germany, drivers with one company receive a CD showing a simulation of the route they are to follow, so that the evening before the journey, the driver can prepare for the route. In Belgium, there are 11 training centres with simulators, where a whole range of situations can be trained for. In Hong Kong, there are even linked simulators. These make it possible to present the effects of for example actions by the driver, on the train traffic controller and station manager, and vice versa.

Subroutes
Through simulator training, the expectation pattern of drivers can be broken down. If through changes to the VPT system, drivers are faced more often than in the past with subroutes, it is possible through simulator training to respond to these changing circumstances, in relation to the actions of the driver.

In the field of simulator training, the possibilities are practically unlimited, but at present, insufficient use is made in the Netherlands by the operators and ProRail, and no requirements are imposed by the Minister. Equally, there has been no communication with drivers (for example through other training methods) about the changes resulting from the introduction of the VPT system.

In the framework of “Amsterdam”, the Council had an investigation carried out into the way in which the (major) operating companies have dealt with the STS problem, over the last few years. It emerged from this investigation that the operating companies and IVW are aware of the STS problem.

[18] The Rotterdam public transport company.

However, only incidental initiatives have been developed to restrict the problem. In 1998, NSR did draw up specific targets for reducing the number of cases of driving through stop signals.

This picture of limited priority for safety that emerges from the examples outlined above is confirmed by the results of this investigation. The investigation shows that at present, there is no systematic analysis or measurement of the driving behaviour of drivers. In addition, the causes of an STS passage are not systematically analysed. Furthermore, there is no structural or recorded communication or information exchange between management and drivers, nor any form of feedback, as a result of which these problems are never discussed publicly. The consequence of this situation is that improvements on safety are being hindered.

Another fact illustrated by the examples above is that there are numerous possibilities for positively influencing the driving behaviour of drivers, and in that way perhaps reducing the number of STS passages. These opportunities are currently insufficiently utilised. This means that there is no good safety management system. More active safety management for both drivers and the management is necessary. Operating companies have taken cautious initiatives in that direction. However, in the vision of the Council, the final objective is still a long way away, and safety is given insufficient priority. Safety is an aspect of the normal operating process. Just like the other aspects (for example financing), this aspect must be guided by realistic targets, regular measurements and feedback. Only in this way is it possible to objectively determine whether safety management has reached a responsible level.

5.3.5. Why are responsibilities being insufficiently taken, in practice?

ProRail

In 1995, the Netherlands Railways (NS) was split up. Until that time, management and operation of the railway system were in the hands of NS. From 1995 onwards, Railinfrabeheer was made responsible for maintenance and track construction. Railned shared the available rail capacity between the admitted transport companies. Finally, Railverkeersleiding (Rail Traffic Control) was responsible for daily train traffic, including recovery following disruptions and passenger information. Since 1 January 2003, these three companies have been brought together in ProRail. From that same moment, the railway inspection tasks of Railned were placed with the Transport and Water Management Inspectorate (IVW).

In order to carry out management and maintenance, until 2003, Railinfrabeheer submitted an annual ‘Subsidy Application for capital costs and maintenance’. Since 2003, there has been no such Subsidy Application; instead, ProRail submits an annual Management Plan, describing what ProRail intends to do over the coming year, and the accompanying costs.

In the Subsidy Application by Railinfrabeheer in 2001 and 2002, there are no specific agreements between Railinfrabeheer and the Ministry in respect of safety. An application is submitted for a particular subsidy, but Railinfrabeheer failed to specify the safety performance it would be providing, in return. In the Subsidy Application for 2003, the following appears in the appendix:

> *“The general safety objectives are: Railinfrabeheer wishes to contribute to complying with the objectives laid down in the Railway Safety Framework Document: Maintaining the current safety standard (standstill) for passengers, passers-by and personnel in the train”……”Professionalising safety management by (further) developing and implementing the principles of this policy”.*

No specific agreements were reached on safety, or indeed, in any other field.

Since 2004, there has been a Management Concession. This concession states that ProRail must operate an adequate safety management system, and that it must be possible to safely and effectively travel the main infrastructure. On the basis of this Management Concession, ProRail draws up the Management Plan, that lays down what actions will be taken by ProRail, and the resultant costs. On the basis of this plan, that is approved by the Minister, an annual subsidy is granted. Once again in this Management Plan, no specific performance is laid down for safety.

The task of ensuring that ProRail complies with the rules has been implemented since 2003 by IVW. Before 2003, Railned carried out this task at Railinfrabeheer. Railinfrabeheer was not subordinate to

Railned, as a result of which Railinfrabeheer made no contribution to the certification procedure or audits at Railned. Also there was no legal basis for this certification procedure or for the decision whether or not to grant a safety certificate. Both questions were settled via an agreement (admission agreement) which operators were required to enter into, if they wished to be admitted to the railway network. However, Railinfrabeheer was not an operator, and never signed an admission agreement. The Management Concession for 2004 is the first concession signed by the manager, and is therefore the first document in which agreements are laid down between the Minister and ProRail. The same applies for the ProRail Management Plan for 2004. IVW is required to ensure that ProRail operates according to the rules and frameworks. To date, this supervisory function by IVW has barely been implemented in concrete terms, for ProRail. IVW has announced its intention for the first time to carry out an audit within ProRail, in the coming year.

In summary, this means that Railinfrabeheer (pre-2003) with its Subsidy Application could not be called to account by the Minister of Transport, Public Works and Water Management for the limited taking up of its responsibility in implementing a safe railway infrastructure. The same applies for today's ProRail (post-2003), because neither the Management Concession nor the Management Plan contain specific, clearly demonstrable agreements between ProRail and the Minister. The supervisory role of IVW at ProRail has equally been barely implemented, as yet.

Operators

Operators wishing to use the railway network will on request be awarded a safety certificate, if audits by IVW indicate that IVW believes that the operator is able to make sufficiently safe use of the railway network. Since 1-1-2005, this has been laid down in law via the new Railways Act. However, the old Railways Act (1875) contains no heading for safety certificates, as a result of which before 2005, there was merely an agreement between operators and the Minister relating to the safety certificates. Despite the fact that there was no legal obligation, this process of allocating safety certificates was laid down in standard sheets from Railned ((V001 and V002). These standard sheets also contain requirements which can be imposed on the safety management system, the application for a certificate and the approval procedure. These standard sheets have now been replaced by legislation, but they still match in terms of content.

Between NSR and the Ministry, no clear, demonstrable agreements have been reached as to how safety will be implemented. As a result, there is no question of complying with contractual agreements in respect of safety. In the Framework Document 1999, it is stated that '*Within the frameworks and standards imposed, the transport companies are responsible for safe implementation of rail travel'.*

At present, there is no need for the operators to make continuous efforts to improve safety. As long as the operators comply with the frameworks imposed and are awarded a safety certificate, there is no reason to make any changes. In addition, IVW, the organisation that occupies a supervisory role in respect of implementation of safety by operators, in practice has as its ultimate sanction a discussion with the department heads of IVW. Their authority to not grant a safety certificate to an operator is in fact never exercised, in practice. The audits undertaken by IVW mainly take place at organisational level, and are primarily based on opinions of the management and an analysis of documents.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. CONCLUSIONS

On the basis of this investigation, the Council has identified five conclusions, namely:

1. Increased number of STS passages
The passing of a red signal, or Stop Signal (STS), as occurred in the accident in Amsterdam, is not an exceptional situation. In 2004, 283 STS passages were recorded. From an analysis of the number of STS passages, it emerges that in particular since 1996, a clearly upward trend has been noticeable, in the number of STS passages. The passing of an STS represents a major risk. When a red light is passed, the consequences are unpredictable and uncontrollable. It may turn out well, but it may also turn out badly. Since the accident in Dordrecht (1999) to date, 14 serious collisions have taken place as a result of passing an STS. In the opinion of the Council, the risk of STS passages has increased to an unacceptable degree.

2. Regulation focused on the individual responsibility of parties involved in respect of safety
Since 1996, safety certificates have been awarded to operators, on the basis of an assessment of their safety management system, thus guaranteeing that the operator is responsible for 'continuous improvement of the level of safety'.
In the Framework Document that describes the railways policy, the requirement is stated that operators and ProRail must have a safety management system, of which all components and regulations are demonstrably present within the company. In current regulations, but also in the regulations post-1995 (the split-up of NS), it is specified that the principle continues to apply that measures with a positive effect on safety must certainly not be ignored (ALARP).

On the basis of regulations since 1995, the operators and ProRail have been given individual responsibility in terms of implementing safety. Within the safety frameworks imposed by the Ministry of Transport, Public Works and Water Management, it is stated that work must be carried out as safely as possible, whilst there must be a continuous creative search for improvements in respect of safety.

3. The parties involved do not take up their responsibility to a sufficient extent, and fail to make sufficiently transparent whether or not the level of safety is continuously being improved
This investigation has confirmed the doubts of the Council for Transport Safety expressed in 2001 following the "Dordrecht" investigation, concerning the relative priority for safety attributed by ProRail and the operators, and hence their implementation of their responsibility for railway safety. This conclusion is based on the following facts, which emerged from this investigation:

- The relevant conclusion on the relative priority of safety from the "Dordrecht" report has not visibly resulted in any policy change, after four years[19].
- In the "Dordrecht" report, caution is recommended in the setting of subroutes. The number of subroutes set by ProRail, however, has simply increased and operators have opted to use these subroutes. The operators have failed to communicate sufficiently with drivers about the consequences of the introduction of subroutes. There has been no analysis by operators of the number of subroutes used, despite the fact that it should have been known that this introduction

[19] **Passage from the conclusion of the Dordrecht report May 2001.** "To a considerable extent, safety is dependent on the correct combination of technical provisions and human task implementation. Whether this combination receives the optimum form is always a continuous source of concern, and should therefore be continuously and systematically monitored, in an integrated manner. For this purpose, a safety management philosophy is required, which consists of a working safety management system, supported by a safety culture. The investigation provides reasons to doubt the relative priority given to safety in the organisation at Railinfrabeheer, NS Passengers, Railned and Rail Traffic Control, and the quality of decision making in respect of safety. In this connection, the question emerges as to whether the safety management systems of these organisations, and above all the coordination between the systems, are sufficient. Indicators for these doubts are: (i) the absence of initiatives for arriving at a replacement of the outdated Automatic Train traffic control system (ATB), (ii) the implementation of designs whereby the components are insufficiently harmonised, (iii) the faulty application and enforcement of legislation and regulations and internal standards, (iv) the policy on setting subroutes to limit delays, without managing possible increased risks, (v) the decision to remove the automatic red light passage alarm and (vi) the late response to the massive growth in the number of red light passages. As a consequence, in small steps, dependency on human task implementation has increased. The unavoidable statistics on human failure mean that incidents and accidents will only increase, rather than decrease. The remedy to this situation must above all be sought in a more systematic application of safety management, supported by a safety culture. These two factors determine the framework and parameters within which the drivers and other employees do their work. The two could represent an important stimulus for doing this work, well."

has a negative influence on the driving behaviour of their drivers. ProRail and the operators have effectively placed the continued smooth flow of train traffic above train safety.

- In the “Dordrecht” report, the operators are recommended to take measures, aimed at reducing the number of STS passages in the immediate future. Given the absence of the essential reduction in the number of STS passages per year, the measures taken by the operators seem to have had no effect. Nonetheless, following an initiative by the Minister and the STS working group, in which ProRail and the operators are participants, after only a few months it emerges that a solution is possible according to which, in the opinion of the working group itself, the number of STS passages can be reduced by approximately 20%, and the current STS risks by 80%. If the parties involved believed that such measures could not be financed by themselves, the operators and ProRail could have actively duly informed the Minister. Such notice was never issued.
- Although there was already an STS working group, it took until 2004, and after 12 STS accidents since the “Dordrecht” accident, before ProRail and the operators, at the personal initiative of the Minister, came up with a serious sector-wide approach to the STS problem.
- Other examples also indicate that ProRail and the operators are only taking their personal responsibilities to a limited extent, for example: (i) no longer fundamentally investigating their own accidents, (ii) not using the available potential possibilities for reducing the number of STS passages, (iii) failing to carry out a fundamental investigation prior to the introduction of the GSM telephone system, and failing to carry out an analysis of the influence of calling and being called during operational service and (iv) carrying out no structural investigation into the driving behaviour of drivers.
- At present, within the companies of the operators, there is no structural or specified form of feedback or communication between management and drivers. There is also no systematic form of analysis and measurement of drivers’ driving behaviour.
- The conviction projected by the management of ProRail and the operators, that the railways are a safe form of transport, does not contribute to a safety culture aimed at continuous improvement, based on the ALARP principle.

4. Efforts of Minister and IVW not aimed at promoting the taking up of personal responsibilities

The Minister of Transport, Public Works and Water Management bears system responsibility and is therefore responsible for the drawing up of all standards and frameworks relating to the transport system, hence also for the setting of requirements for safety (for example imposing standards and performance indicators for safety, in the same way as for punctuality) and maintaining supervision of implementation.

The role of the Ministry of Transport, Public Works and Water Management as responsible for the railway system leaves room for improvement, as is demonstrated by the following points:

- Following the split-up of NS in 1995, agreements (regulations, legislation and contracts) were drawn up in respect of safety. With ProRail (and before that time with Railinfrabeheer and Railverkeersleiding), no solid, demonstrable safety agreements were made. In the Management Concession of 1 December 2004 although a duty of care for safety was included, no specific requirements were imposed by the Ministry of Transport, Public Works and Water Management.
- The Netherlands Railways, even before the reorganisation and split-up in 1995, had opted for a major intensification of train traffic in combination with an improved control system. In the years since, the intensification of train traffic has been implemented, as planned, and the number of passengers has risen considerably, whilst at the same time the pressure on punctuality and continuous flow has been raised. However, adjusting the control system to this changed situation has not happened. As a consequence, the safety level has not been maintained, but has fallen.
- Although the number of STS passages has risen considerably, year on year, and although the problem was known, and since “Dordrecht” 12 accidents have occurred as a result of an STS passage, only in 2004 was any specific action taken by the Minister, in order to tackle the problem, sector-wide.
- Based on the recommendations from the Council following “Dordrecht”, to identify the phasing according to which the current ATB system would be replaced, the Minister indicated that no specific plans could be provided. Furthermore, the Minister indicated that such a new control system would not be introduced on safety grounds alone.
- In 1999, despite the fact that the number of STS passages in that year had almost doubled as compared with the number in 1995, the Minister allowed the training requirements of drivers to be considerably reduced.

- The form of direction (rules and/or inspections) by the Ministry of Transport, Public Works and Water Management has contributed to the fact that ProRail and the operators have insufficiently taken their responsibility for safety. No clear agreements have been reached between the Ministry and the operators concerning the way in which safety should be implemented. The supervisory role of IVW has also emerged as only having been implemented to a limited extent, in practice; as long as the operators broadly speaking comply with the frameworks imposed, they will be awarded a safety certificate; a situation that does not encourage additional safety initiatives. The supervisory role at ProRail has to date been almost entirely ignored.

5. Long-term solution for STS problem remains essential

Long before the reorganisation and split-up in 1995, the Netherlands Railways chose to massively intensify train traffic, in combination with an improved control system. The goal was with 50% more trains, to double the number of passengers, whilst maintaining the safety level from 1990. In the subsequent years, intensification of train traffic has been implemented, whilst at the same time the pressure on punctuality and continuous traffic flow has been increased. However, the control system was not adapted to this changing situation. The safety level has as a result not been maintained, but has fallen. The development of the new control system ATB New Generation was halted, because the new system, like the old ATB system, would specifically generate a barrier to cross-border rail traffic, such that this development was not in line with the intended European integration. In addition, the high expectations of the European system it seems are in fact too high.

Despite these developments which negatively influence the introduction in the near future of a new control system in the Netherlands, the Council continues to believe that the STS problem can only be solved in a structural manner, by fitting all trains with a system of continuous automatic speed control, a feature which is a component for example of the ETCS system or ATB New Generation. This means that the speed of the train is continuously monitored from the point of departure, and a determination is made as to whether the speed is low enough to be able to slow the train to stationary, before the red light, based on the available braking capacity and the still remaining braking distance. As soon as the speed of the train threatens to rise too high, the train is immediately automatically braked to a suitable speed, in the given situation. Because no decision has yet been taken to install a system of continuous automatic speed control, and given that development of such a system will take at least several more years, for the coming 10 years, this system represents no solution to the STS problem. After the decision to install the ATB First Generation (shortly after Harmelen 1962), it took another 30 years before the entire network was equipped with the system.

Given the long lead time for the introduction of a structural solution to the STS problem, the STS working group has set itself the target, in the immediate future, of reducing the number of STS passages. To this end, the Minister has made € 40 million available. For this amount, approx. 1000 locations can be fitted with the so-called ABT++ system. The STS working group has itself indicated that using the ATB++ system, a reduction of 20% of the number of STS passages and 80% of he STS risks can be achieved. However, the ATB++ system takes no account of any European standard, is only capable of reducing the number of STS passages, and will only be tested on a limited scale. On the other hand, the Council does share the opinion of the working group that these measures will make a contribution to reducing the number of STS passages. Furthermore, the Council would emphasise the importance of this plan, given that all parties involved are participants in the STS working group, and that all have in this way committed to reducing the number of STS passages by 20% and the STS risks by 80%.

However, the only really sound approach to the STS problem in the long term, in the opinion of the Council, remains the introduction of a responsible control system with continuous automatic speed control, like that included in the ATB New Generation and ETCS systems.

6.2. RECOMMENDATIONS

1. The Minister of Transport, Public Works and Water Management, ProRail, the operators and the Transport and Water Management Inspectorate are recommended to supervise implementation of the 'STS reduction plan', of the STS working group, by critically monitoring and evaluating the progress and results, and working on a renewed European ATB system for the long term, whereby the speed of trains is continuously and automatically controlled.
2. The Minister of Transport, Public Works and Water Management is recommended, to that end, to draw up a concrete plan in which a timetable is included, which lays down the implementation of the continuous automatic speed control.
3. ProRail and the operators are recommended to take up and put into practice their own responsibility for safety by demonstrating that they operate as safety as possible (ALARP) within the possible safety limitations of the railway system (ATB, visibility of signals, rail characteristics, etc.). However, they should nonetheless work progressively and creatively on solving these problems. In this respect, they should not in advance exclude drastic measures (e.g. reducing train frequencies), and communicating clearly on these matters with the Ministry of Transport, Public Works and Water Management, as the body responsible for the system.
4. The Minister of Transport, Public Works and Water Management is recommended to improve the effectiveness of guidance and inspection of ProRail and the operators, under all circumstances by:
   - formulating clear, company-specific safety targets (for example concrete reduction in number of STS passages), which are 'compulsory' for the parties involved.
   - explicitly basing the concessions, safety certificates and supervision on the assessment of the quality of application in daily practice of the safety management system of the parties involved[20].
   - undertaking an evaluation of the degree to which the safety certificate has contributed to the quality of the safety management and safety culture of the operators.
   - altering the measurement of train punctuality in such a way that in determining punctuality of rail traffic, only the arrival time of trains is counted, and not, as is currently the case, also the departure time.

[20] If necessary, consequences should be attached in the form of the withdrawing of the concessions.

APPENDIX 1: ANALYSIS OF TRAIN COLLISIONS PERIOD 1999 – to present[21]

Introduction - general

Figure B1 shows a simplified diagram of the railway network:

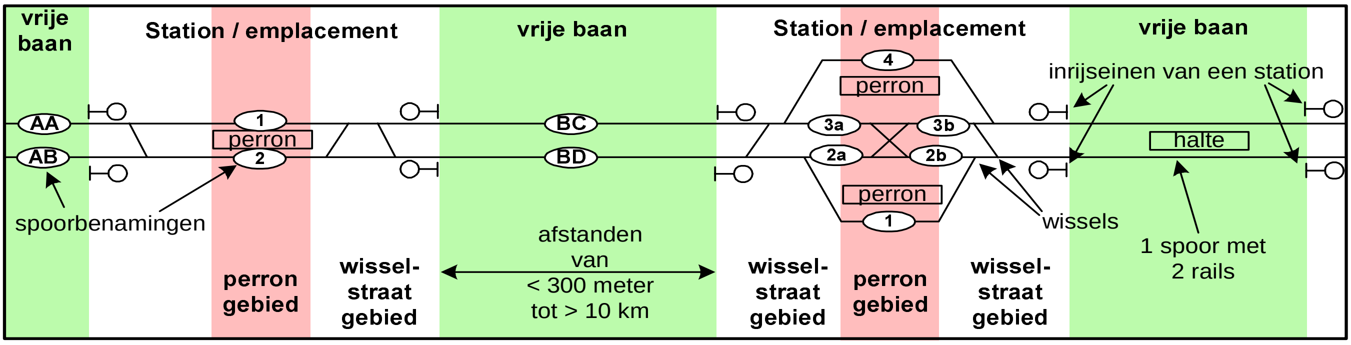


Figure B1: Simplified diagram of the railway network, identifying open track, platform area and gridiron.

The open track is a track between two stations without points and subject to fully-automatic protection. The open track may consist of one or more tracks. A stop is an embarkation/debarkation point on the open track. A station has operable signals and at least one set of points. A gridiron is a set of two or more points passed through one after the other by a train. The gridiron area here refers to the area between the platform area of the station and the open track. At stations, a train traffic controller is responsible for operating signals and points. The more points and tracks at a station, and the more open track section tracks, the more trains can depart and arrive simultaneously.

1.Zwolle 21 May 2001

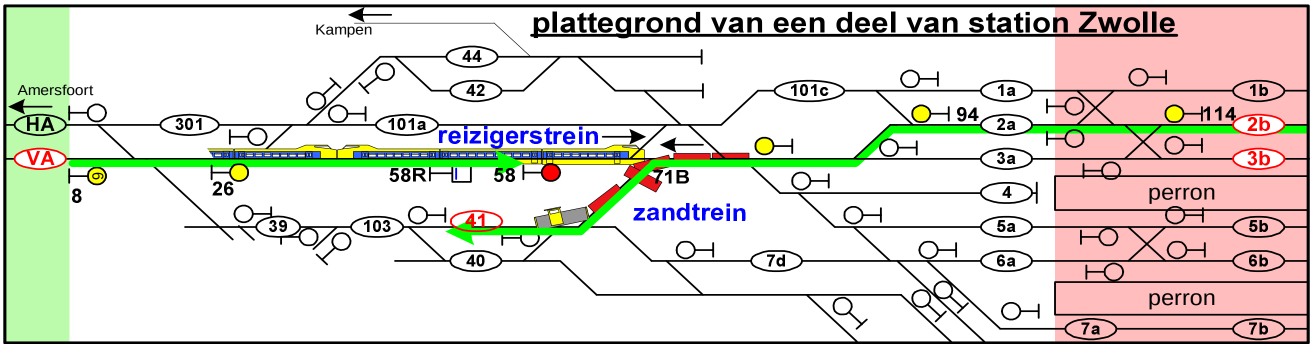


Figure B2: Diagrammatic situation. On 21 May 2001, an incoming passenger train passed stop signal 58 and collided at point 71B laterally against a goods train with 22 wagons full of sand. For the sand train from Meppel, a route had been set via track 2b to track 41 and for the passenger train a route from track VA to signal 58. The train had to continue on to track 3b (the tracks and trains are not drawn to scale). ***Evaluation: This was a subroute in a gridiron, which should have been avoided.***

Figure B3.
Zwolle 21 May 2001. Passenger train 569 passed red stop signal 58 and collided laterally with a goods train loaded with sand, travelling in the opposite direction.

[21] Source: This appendix is in part based on an investigation carried out on behalf of the Council for Transport Safety.

2. Utrecht 13 June 2001

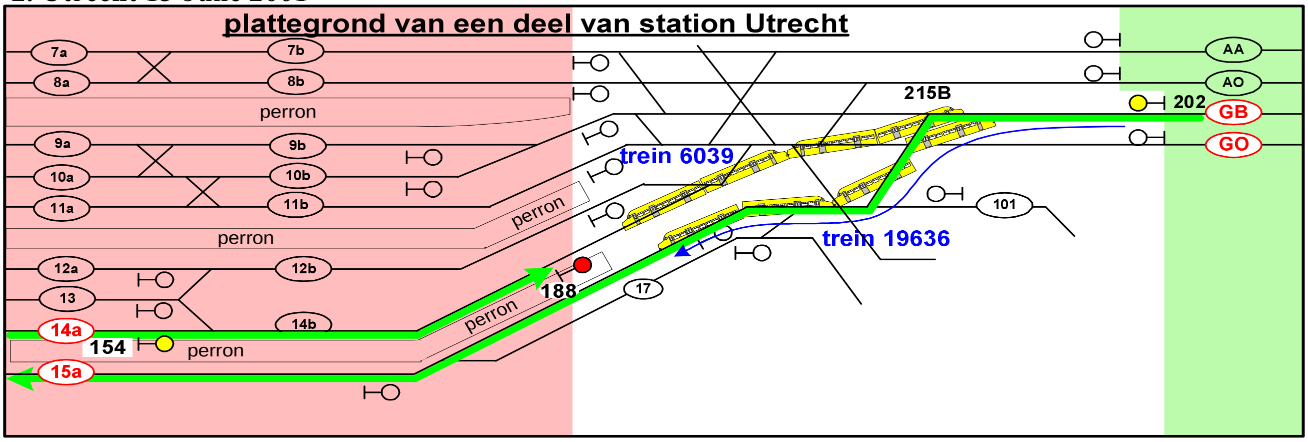


Figure B4: Diagrammatic track situation. On 13 June 2001, passenger train 6039 passed stop signal 188 and at point 215B collided laterally with the incoming passenger train 19636. On the incoming train, the last carriage broke off at the bellows. For this train, a route had been set from track GB to track 15a. For the departing train, a route had been set from track 14a to signal 188. The train was set to continue on to track GO. ***Accident evaluation: This was a subroute, which under no circumstances is permissible. The subroute was automatically set.***

Figure B5.
Utrecht 13 June 2001. Flanking collision at points 215B. On the right the front of the departing passenger train 6039, which passed through stop signal 188. On the left the rear of passenger train 16936 for which a route had been set from outside the station to past the platform on track 15.

3. Amsterdam 27 November 2001

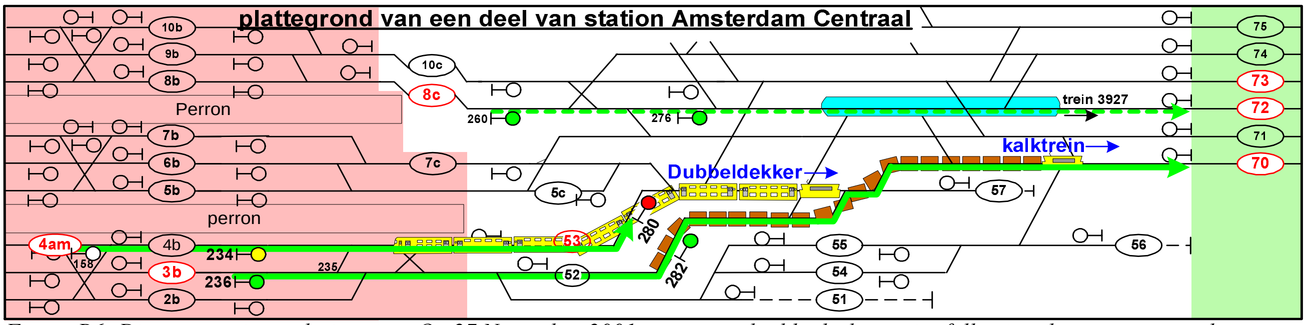


Figure B6: Diagrammatic track situation. On 27 November 2001, an empty double decker train, following departure, passed stop signal 280 and collided laterally against a departing lime train. For the lime train, a route had been set from track 3b to track 70 and for the double decker from track 4am to track 53. From track 8c, a passenger train had departed to track 72, as a result of which the double decker could not continue from track 53 to track 73. ***Accident evaluation: This was a subroute, which should have been avoided.***

Figure B7.
Amsterdam 27-11-2001. On the right the double decker passenger train which after passing stop signal 280 collided with the unladen lime train. Wagons of the goods train derailed. The catenary was brought down.

4. Amersfoort 26 June 2002

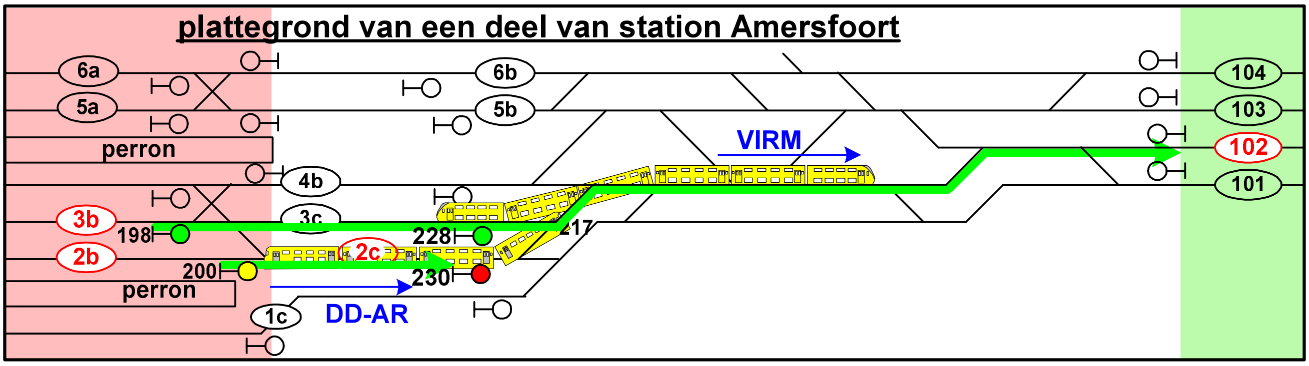


Figure B8: Diagrammatic track situation. On 26 June 2002, a double decker passenger train (DD-AR) passed stop signal 230 and collided against the flank of an empty double decker train (VIRM). In this diagram, the moment is indicated whereby the trains touched and collided with one another. The VIRM continued to travel a short distance. For the VIRM , a route was set from track 3b to track 102. The DD-AR had to travel from track 2b also to track 102. ***Accident assessment: This was a subroute, which should have been avoided.***

Figure B9.
Amersfoort 26 June 2002. Passenger train 5645 (DD-AR right) passed stop signal 230 and subsequently collided with the flank of test train 82172 (VIRM in the centre of the photograph). The last carriages of the VIRM derailed to the left, and found their way between the catenary support column and passenger train.

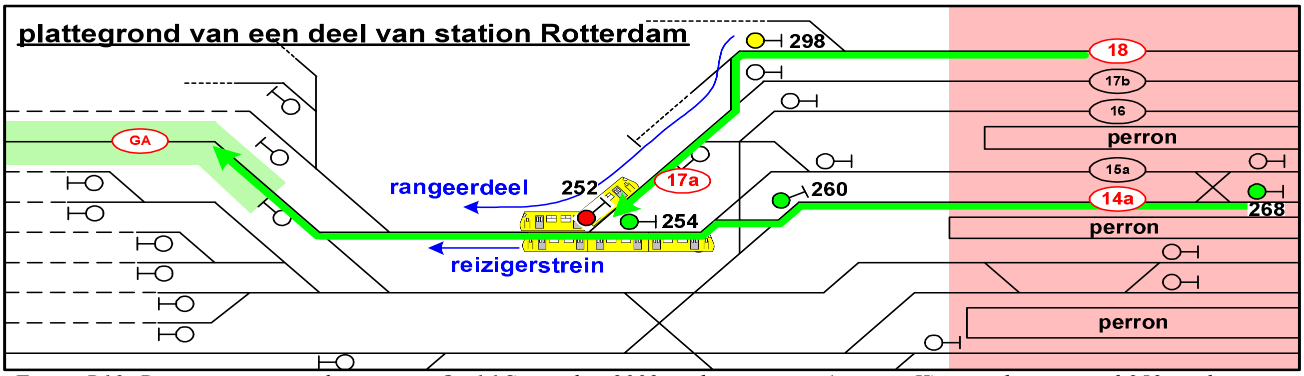


Figure B10: Diagrammatic track situation. On 16 September 2002, a shunting unit (sprinter II) passed stop signal 252 and collided at point 253 against the flank of a departing passenger train (sprinter III). A route had been set for the passenger train from track 14a to track GA. For the shunting unit, a route was set from track 18 to track 17a. The shunting unit had to transfer to track GA and then back to platform track 3. ***Accident assessment: This was a subroute which should have been avoided.***

Figure B11.
Rotterdam 16 September 2002. *On the left the front of the shunting unit which passed stop signal 252. On the right the front of passenger train 9731, which was hit in the flank by the shunting unit.*
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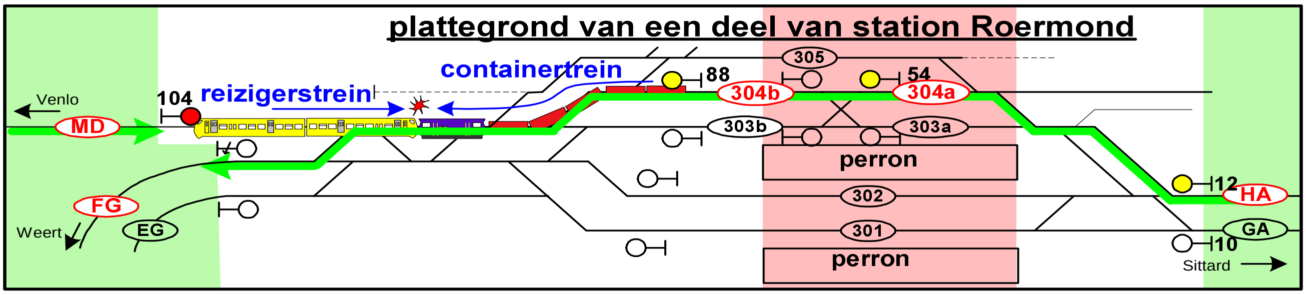

Figure B12: Diagrammatic track situation. On 20 March 2003, a passenger train passed the station entry signal 104, at red. For a goods train with containers, which arrived 4 minutes early, a route was set from track HA via track 304ab to track FG. The passenger train collided head on with the container train. In these accidents, "Roermond" was added, but no actual subroute was set. However, a pre-programmed route was used in this case. ***Accident assessment: Use was made of a planned route via track 304ab, not a subroute. There was an alternative route available via track 301 (302 was not available).***

Figure B13.

Roermond 20 March 2003. Passenger train 16337 passed stop signal 104, and collided head on with a laden goods train.

7. Utrecht 17 June 2003

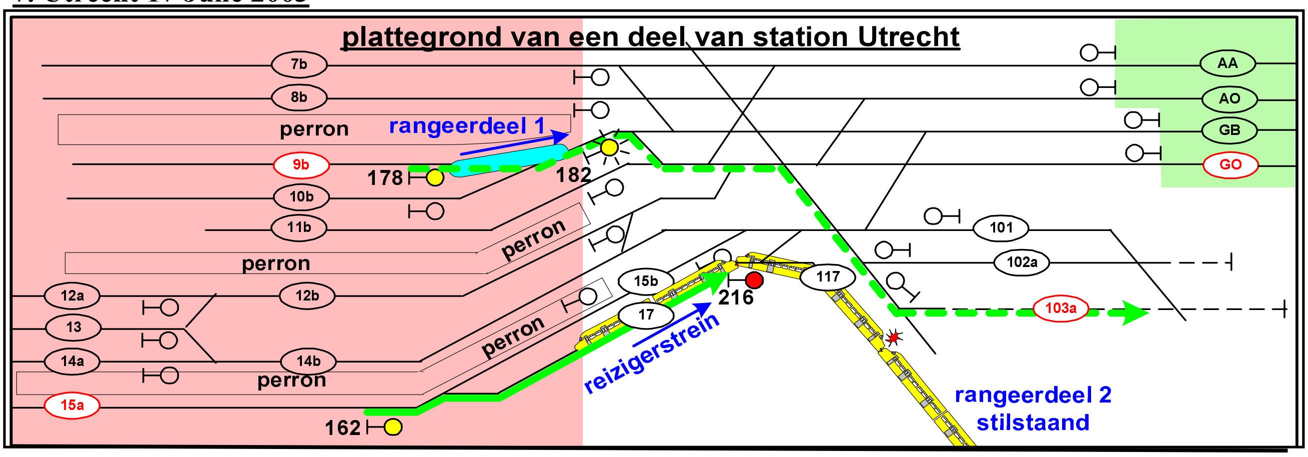

Figure B14: Diagrammatic track situation. On 17 June 2003, a departing passenger train passed stop signal 216. For the passenger train, a route was set from track 15a to track 17. The train had to transfer to track GO. For a shunting unit (1), a route was set from track 9b to track 103a. On track 117, another shunting unit (2) was standing ready. The passenger train collided head on with the stationary shunting unit. ***Assessment: This was a subroute which should have been avoided.***

Figure B15.
Utrecht 17 June 2003. Passenger train 19645, after leaving track 15a, passed through stop signal 216 on track 17 and collided with a stationary shunting unit of the same stock, on track 117.

8. Amsterdam 21 May 2004

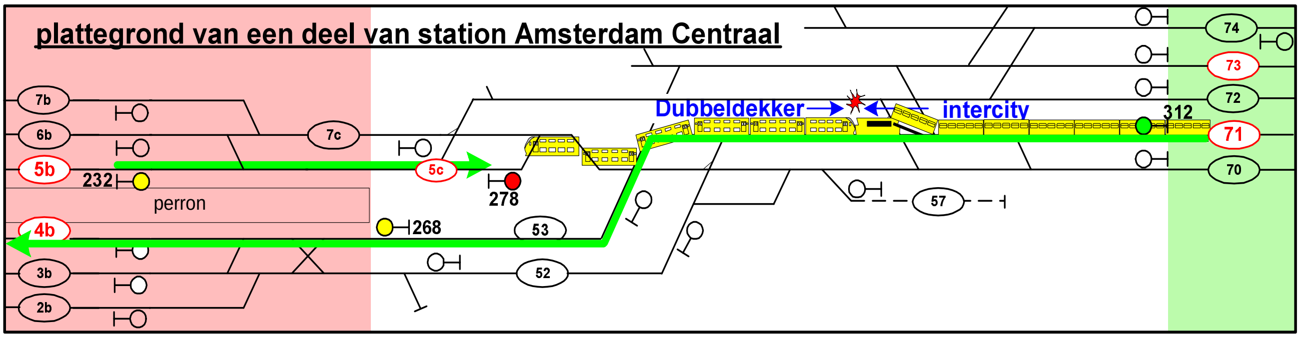

Figure B16: Diagrammatic track situation. On 21 May 2004, an empty double decker train, following departure, passed stop signal 278 and collided head on with the incoming intercity from Utrecht. For the intercity, a route was set from track 71 to track 4b. For the double decker train, a route was set from track 5b to track 5c as far as signal 278. The train had to transfer to track 73. ***Assessment: This was a subroute which should have been avoided. For the double decker, an alternative route was available.***

Figure B17.
Amsterdam 21 May 2004. *Train 80761 (empty double decker train VRM), following departure, passed stop signal 278. The double decker (right on the photograph) collided head on with the incoming intercity 960 from Utrecht. The first carriage of this passenger train was lifted up and folded double on the roof of the locomotive.*

9. Roosendaal 30 September 2004

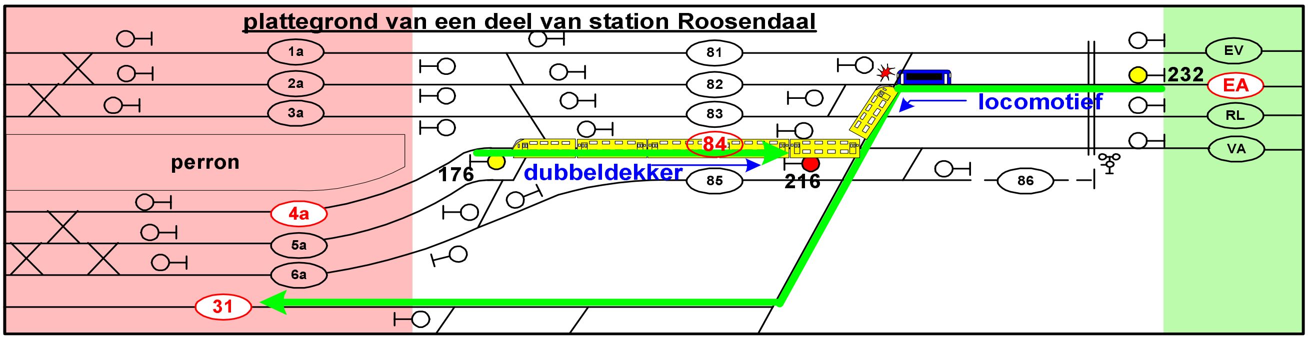

Figure B18: Diagrammatic track situation. On 30 September 2004, a double decker train, following departure, passed signal 216. For this train, a route had been set from track 4a to track 84. The train had to transfer to track VA. For a Belgian locomotive, a route was set from track EA to track 31. The two trains collided head on with one another. ***Assessment: This is a subroute which should have been avoided.***

*Figure B19.*Roosendaal 30 September 2004. *Following departure, passenger train 2163 passed stop signal 216 and collided head on with the incoming locomotive. On the left the passenger train with a kink in the crumple zone behind the platform. On the right the crumpled locomotive.*

10. Rotterdam 11 February 2005

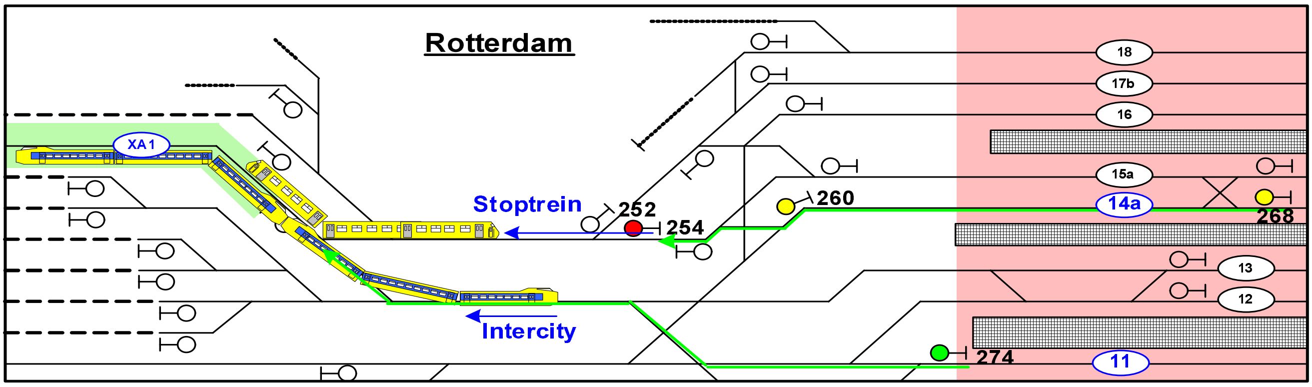

Figure B20: Diagrammatic track situation. On 11 February 2005, a stopping train (sprinter III) passed stop signal 254 and collided with the flank of an Intercity (2 train sets ICM-3). For the Intercity, a route was set from track 11 to track XA1. For the stopping train, a route was set from signal 268 to signal 254. ***Accident assessment: This was a subroute which should have been avoided.***

Figure B21.
Rotterdam 11 February 2005. On the right the front section of stopping train 9725 (sprinter), which passed stop signal 254 and collided with the right flank of intercity 21723 (ICM).