An Unexpected End to the Journey

An introduction to international accidents on and around railways

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(leesproef)

4.62 Stavoren, The Netherlands, 25 07 2010 at approx 23:30

(End-of-line crash with on-track rail grinding machine due to poor preparation and distraction of hired-in train pilot)

The accident

The last incident in this chapter was not an occasion in which people were killed or badly hurt. Two people were slightly injured but were able to walk away from the massive wreckage (estimated at €20 million) when a rail grinding train was driven at 80 km/h (50 mph) through the stop blocks at the far end of the non-electrified line from Leeuwarden into the single-line and single-platform station of the Friesian harbour town of Stavoren. This accident represents the ultimate fear of any train driver who is not completely certain about the location of the end of a railway line ahead. The majority of responsible train drivers would have taken it very easy with speed in such circumstances, but in this instance it all went wrong.

The accident log

The train had been grinding elsewhere and had been brought to one of the three operational permanent-way rail grinding servicing bases in The Netherlands. This one was at a yard called Rotterdam Noord Goederen, where fuel and fire extinguishing water were taken on and further servicing of the mobile grinding installation took place. (Grinders have a tendency to set fire to rubbish and dry vegetation at the surrounding trackside. The last rail grinding action, therefore, is spraying water to extinguish any such potential conflagration.)

The Italian grinder crew had been transferred to a hotel in Zwolle in order to stay within their legal working hours and the hired Dutch pilot driver would board the train there as well. At about this time a change of plans was agreed between back-office staff working on the grinding run that night. The train would go all the way to Stavoren instead of terminating and returning for grinding at Sneek, as a time gain of 30 minutes could be obtained that way. None of the head offices involved were informed about this change of plans. One important change was that the possession of the line would not now take place from Leeuwarden onwards (which was the chief reason for the time gain, as there would be no waiting for the last evening trains to clear the line) but the train would run all the way to Stavoren on track in normal service and start the grinding run from there. This change increased the permitted speed from 40 km/h (25 mph) in a track possession to the permitted maximum line speed of

100 km/h (60 mph), so the grinder could be run at its permitted maximum speed of 95 km/h (59 mph).

Running dead behind a locomotive, the grinding train had been dispatched from Rotterdam to the freight yard at Zwolle Goederen, where it arrived with the grinder crew and pilot waiting to take over. The crew prepared the machine for its onward trip under its own power to Leeuwarden, for which destination they departed at 19:00. Arriving at Leeuwarden, the pilot was informed about the change of plans with regard to continuing to Stavoren. As the Italian grinding crew thought it would be a considerably longer night ahead than planned they were understandably anxious to know just what was going on, but as yet had not been given a definitive answer.

At 22:16 the train, headlights dimmed and cab lights switched off, departed from Leeuwarden along the single track to the junction of the Harlingen and Stavoren lines. In this section the on-board ATBEG-v ATP equipment switched out due to leaving the ATBEG-protected area. On normal service trains the ATBNG equipment would then have switched in as explained before (see ***Roermond***), but this train had no such NG equipment on board and was consequently now running at maximum speed without any train protection supervising the journey. At the Harlingen/Stavoren junction the train took the left-hand track towards Stavoren and stopped at Mantgum station for 26 minutes to let two late-evening trains cross, after which the journey continued. Stops of half a minute each were again necessary at Sneek, Workum and Hindeloopen for signalling purposes. After the Hindeloopen stop at 23:18 there was telephone contact in which the hired pilot announced that he was about 2 km (1¼ miles) from Stavoren.

At this point the (illegally present) Italian grinder operator in the front cab started to ask pertinent questions again about the revised time schedules for the job ahead, for which the pilot had to consult notes and revised time diagrams. The conversation was conducted in halting German, which more than once caused the pilot to turn towards the operator seated behind him to see whether he was understood. At one such moment the train passed the three 'keperbaak' fixed distant boards, situated 70 m (230 ft) apart at a distance of 1,200 m (3,940 ft) from the buffer stops and normally protected by ATBNG ATP, travelling at 95 km/h (59 mph). These went completely unnoticed by the pilot, so no reduction of train speed was made. About 200 m (660 ft) past the fixed distant boards the train passed the well-illuminated 'Koeweg/Kooijweg' AHB level crossing at maximum speed, where several p-way men were waiting to travel back with them, working on the grinder for protection of level crossings against road surface damage. Noticing the excessive speed of the train, they attempted to gain the attention of the grinder crew with arm gestures, but were unsuccessful. The operator seated in the rear cab did see them, however, and used the intercom to the front cab to ask whether they were approaching their destination yet. The pilot thought he recognised the level crossing and expected to see at any moment the speed boards he had selected on his diagram to indicate the end of the line. As he was looking for a kilometre/hectometre post for orientation, all of a sudden he spotted the station platform coming up in the headlights. He shouted, 'Bremsen, bremsen, bremsen' (brake, brake, brake) to the train driver, who immediately put his train brake in the emergency position, but to no avail. The three men had time to leave the cab and position themselves against the rear of the cab bulkhead to await impact just before the train crashed through the stop blocks at the end of the platform at about 80 km/h (50 mph).

After running through the stop block and off the track, the derailed train continued its journey more or less in line across the street, picking up an empty marine diesel-fuel road tanker and smashing it clean through a large watersports and ship chandler's warehouse and shop, demolishing about a third of the premises in the process. About 70 m (230 ft) further on, the train finally came to rest in a zigzag amidst a mass of debris, the rear vehicles still on the track. Fortunately, because it was about midnight no one was in the shops and on the streets near the station when the accident happened. Under different circumstances it could have been far worse, as indeed it could have been at ***Carcassonne***. Unlike Carcassonne, however, the resulting damage was enormous and took days to remove.

The location, route and the trains that use it

Stavoren, in the province of Friesland, during the early Middle Ages was an important Hanseatic trading port and is one of the many ancient European towns steeped in history and full of character where you might easily imagine encountering a medieval merchant. Still a busy port, it is now also an important watersports centre with substantial commercial shipping to the large inland lakes via the Johan Friso Canal. The landscape in this part of Friesland is rather more picturesque and somewhat less remote than the more northerly and easterly lands of the province of Groningen. During the summer watersports season the Friesian canals and lakes, the Waddenzee islands and shoals, and the nearby IJsselmeer attract large numbers of the boating fraternity from many parts of Europe. The area resembles the Norfolk Broads in eastern England but is substantially bigger in size and population.

The railway line between Stavoren and Leeuwarden was built by the state between 1883 and 1885 (rather late in Dutch rail history) and was constructed as a double-track main line to be operated by the Netherlands State Railway Company. A curious but very recognisable train operating arrangement reveals itself here. Even in those days, the Dutch Government built many less profitable but socially necessary railway lines, which were then run by private operators on payment of access fees. In fact, the so-called State Railway Company had little to do with the state; it was just one of those operators. The line, built to provide good access to the remote south-western corner of the province of Friesland, connected with scheduled rail and steamboat services from Amsterdam via Enkhuizen.

As the State Railway (SS), together with the Netherlands Central Railway (NCS), also controlled the overland rail connection from Amsterdam via Utrecht and Zwolle to Leeuwarden and had clearly set out to obstruct development of the Enkhuizen–Stavoren rail and ferry route in order to protect its greater interests in the land route, the government invited the operator of the ferry connection, the Holland Railway Company (HSM), to assume control of the entire Amsterdam, Enkhuizen, Stavoren and Leeuwarden connection after a number of years of wrangling, after which proper operation took off with a vengeance. Thus, in 1890, Stavoren became the eastern ferry terminus for a passenger service employing three ships, and later, in 1899, a freight train on a ferry boat operation, which from 1909 used three somewhat peculiar-looking ships to cross the Zuider Zee (IJsselmeer) from Enkhuizen, north of Amsterdam. However, this lasted only until the unification of railway operations in The Netherlands under the banner of Netherlands Railways (NS) in 1917 during World War 1 (see ***Weesp***), whilst the opening of the road across the nearby Afsluitdijk (enclosure dam) across the mouth of the Zuider Zee (built 1927-35) ended the commercial viability of ferrying passengers through all weathers once buses had started to run. The two remaining capacious railway passenger ferries operated for one more year until 1 April 1936 under railway control, after which private tourist interests took over in the summer season only. In fact, most years it is still a once-a-day, summer-only tourist connection.

In the days of ferry operations the Stavoren quayside station was an important railway venue with a large station building and its own steam locomotive depot, where boat trains in connection with the ferry departed, and a freight yard to marshal wagons off the train ferry into trains. After closure of the regular freight ferry, the line from Stavoren to Leeuwarden was soon reduced to a single-track branch that became part of the group of non-electrified branch lines in the north of the country known as the Northern Diesel Lines (see ***Winsum*** for another accident in this area). At present Stavoren station consists of only one quayside platform with a shelter alongside the single line with a stop block. However, the character of the ferry port with which it was once linked, Enkhuizen, is still reminiscent of former times.

Rail head checking (gauge corner cracking)

At 12:10 on 17 October 2000, the railways in Britain experienced a fatal derailment near *Hatfield* when about 280 ft (85 m) of rail disintegrated under a London King's Cross to Edinburgh express running at 115 mph (185 km/h), approximately 15 minutes into its journey. Regrettably, four deaths occurred in the overturned buffet car, the roof of which was sliced open by an overhead line catenary post whilst the vehicle was still sliding on its side. Catenary posts, often made up of steel profile beams and presenting sharp edges towards passing trains, pose something of a risk in the event of derailments (as at ***Granville*** in Australia and *Hoofddorp* in The Netherlands). The Hatfield accident, however, made rail head checking, gauge corner cracking and rolling contact fatigue household terms. It also brought the potential dangers of ignoring that type of rail wear firmly to everyone’s attention, as well as heralding the beginning of the end of that politically instigated peculiar British experiment of having a commercial, stock exchange listed company (Railtrack plc) seeking profit for its shareowners at the expense of serious investment in the clapped-out national rail network where such investment was badly needed. Interestingly, after news of the Hatfield derailment broke, it became clear that railways elsewhere were experiencing similar problems. The North American continent suffered, Germany and The Netherlands were plagued by it, and the French admitted that they too had the same problem. What, technically speaking, was the matter?

Until the 1960s, the vast majority of train wheels rolled comparatively roughly on the track and caused considerable wear on the rail head as well as on the wheel treads. Apart from demanding a substantial maintenance effort, this exacerbated the problems of track top and line deterioration. As a result of the quest for higher speed, concurrent with the increased application of concrete for the track base, all sorts of developments in rail and wheel wear detection, as well as in bogie and wheel suspension technology, took place from the 1960s onwards. The main benefit, other than a much quieter ride, was that the rail head and wheel tread no longer wore down so quickly. However, from the moment that these issues ceased to be a problem, the phenomenon of head checking (to use the American and German term) or gauge corner cracking (the British term) started to come to the fore.

Rail movement under passing trains had been checked with heavier track, better fastening and improved track foundation technology, in which concrete increasingly played an important role. The track was made harder, as it were, and the rail no longer flexed up and down to the same extent as on wooden sleepers in the ballast. This gave a markedly quieter and more stable ride, as well as cutting the traction effort to keep the train moving – which is very important at higher speeds – but in turn this demanded rather more from the bogie suspension. That was addressed by better axle guidance with radius arms, primary coil springs with motion dampers and advanced steel coil or air secondary suspension that was fitted with arrays of motion dampers. As a secondary result of that increased track inflexibility, however, the hardened steel of which the rolling wheel threads and rail head itself were manufactured now compressed minutely at the rail/wheel contact points and then expanded again, similar to a road tyre. This started to cause metal fatigue in the tread rim and on the rail head, which in turn caused very thin slivers to break off the contact surface of the rail head as well as off the wheel tread. Such head checking or gauge corner cracking notably affected the two inner rail head top corners, the gauge corners. The main problem was that under certain circumstances – mostly due to steel rail manufacturing characteristics or at rail welding flaws – the cracking, instead of remaining parallel with the rail/wheel contact surface, might turn down into the head and through the web of the rail to set up a rail break or even a series of rail breaks.

It is what led to the disaster at Hatfield, by ignoring visible and known wear symptoms in long stretches of rail. As a result, a stretch of the most stressed rail, that part on the outside of a curve on high-speed track, simply shattered into fragments under the speeding express. The accident report together with Christian Wolmar's account in *Broken Rails* of how that saga unfolded, media and magazine articles (notably Roger Ford's in *Modern Railways*) and some interesting issues raised in internet forum discussions are all particularly instructive. This problem had no doubt existed before, but the more roughly rolling wheels of the passing trains had continuously ground off the head checking problems through wear. With the harder track and the more stable ride of modern bogies with their regularly re-profiled wheels, head checking or gauge corner cracking – now known by the generic and internationally accepted name of rolling contact fatigue (RCF) – became more of a problem.

The solution was found in increasing the re-profiling sequences of the rail head with so-called rail grinding trains. In one pass such a train grinds off a few millimetres of steel from the rail head to restore the proper rail head profile whilst taking away the potentially fatigue-plagued top. It generally prevented the rail break problem, but did add expensive maintenance work to the bill of running a railway. A few contractors were able to develop the necessary technology to grind the track, the oldest and most well known being the Swiss firm of Speno. They work all over the world and build their own track grinding trainsets. Five such sets are permanently based in The Netherlands, two large ones and three smaller ones, and are virtually continuously employed. This gives an indication of the amount of work to be done on a small but heavily used network. It was one of the two large sets that was detailed to grind the recently overhauled track on the remote single line in Friesland.

The effect of privatisation on the line

When privatisation and the concomitant break-up of the European national railway undertakings hit The Netherlands, passenger train operations on the Northern Diesel Lines network were contracted out to private transport operator NoordNed. This company was later taken over by the British Arriva group, which itself is now part of German state railway operator DBAG Regio. A positive result of that development is that modern Stadler-built DMU railcars from Switzerland now ply the tracks and provide three services per hour instead of the ageing and somewhat dreary Netherlands Railways first-generation diesel-hydraulic rolling stock on an hourly and later half-hourly schedule. The bus and train connections, mostly operated by the same company, are superbly co-ordinated, with tightly scheduled interchanges at stations and midway hubs along the tracks and roads. A typical 'if only' experience for the traveller from countries such as Britain.

Route knowledge

To prepare for this job the pilot had selected the track diagram issued by Dutch rail infrastructure provider ProRail, which indicated distances of the features but no curves, and additionally wrongly showed two signalling matters – a speed warning and a speed reduction section commencement board at the end of the line at Stavoren – that had no longer existed for several years already. Unfortunately, because the pilot had failed to inform himself about these details of the local signalling (see below) he selected those non-existent speed boards to find his braking point for the end of the line. During his route-learning trip with a local driver this issue clearly had not been explained, nor had the pilot noticed this important omission.

Train driver route knowledge is a somewhat contentious issue outside Britain, as it is difficult to define accurately what the expression means in terms of what it covers and what its desired effects should be. All train drivers have their own way of getting to know a route, whilst using route knowledge when driving a train is strongly influenced by the type of train being handled and its braking system. There is a tendency on continental networks to look at route knowledge as being of secondary importance, the argument being that if a driver correctly follows up the speed indications at signals and signs along the route he should be fine. They have a point, but a number of recent accidents in Europe can be officially attributed to insufficiently detailed local route knowledge leading to a misreading or overlooking of signals (e.g. ***Pécrot***, ***Brühl*** and *Arnhem*), remarks to that effect being contained in the official reports.

During discussions I had with IRSE past president Wim Coenraad among others, the conclusion was reached that route knowledge on the European continent fills in where certain, usually historical, anomalies in the local track layout or signalling leave a train driver without sufficient information to run his train safely, which was clearly the case during this incident. Whilst in Britain, with its route-indicating junction signalling, the situation is different, on networks with speed-indicating signalling route knowledge is still of importance. One of the essential issues that perhaps should receive some serious future attention in Europe is the standardisation of signs and signals that cover such clear danger points along the tracks. The Italian driver might then have understood that he was at braking distance from the end of the line and would not have needed the pilot to tell him. Moreover, going by the telephone call from Hindeloopen station, the pilot at that moment appeared to have a pretty good idea of where he was, yet failed to assist in stopping the train on time.

The line from Leeuwarden to Stavoren is, in fact, not difficult to get to know. There are a few station loops on the non-electrified single line, with driver-operated block signalling (key in slot or remotely operated with an infrared light gun from the cab) that is protected by ATBNG ATP at the passing loops, and the line runs through a rather flat and featureless landscape. In conjunction with the track diagram, detailed 1:50,000 or 1:100,000 maps reveal the locations of the stations and the way the line fits into the landscape. There are only three clear left-hand curves and three right-hand curves on the entire line, so even without any previous route knowledge, merely counting station loops and curves would have been one way of keeping track of the train's location. The stations on the line are spaced in easily recognisable patterns. Mantgum, with its passing loop, breaks up the long straight from the junction at Leeuwarden to Sneek, after which there are three stations in a close group, Sneek

Noord, Sneek (also with a passing loop) and IJIst. After IJIst there is a right-hand and a left-hand curve, after which come Workum and Hindeloopen stations, the line then skirting the IJsselmeer coast. A further left-hand curve brings you to Koudum-Molkwerum station where you need to start paying attention as there is then less than 5 km (3 miles) to go. The end of the line is imminent when an impossible-to-overlook almost 90° right-hand curve leads into the platform at Stavoren. It is clear even from the maps that after this turn there are just two more level crossings, which would be difficult to miss even on the darkest night, with their bells sounding, red lights flashing and crossing illumination, before finally coming into Stavoren station with a dead straight into the platform.

As has already been said, however, the pilot knew where he was at Hindeloopen, so at that moment route knowledge was not an issue. It was only when distraction set in just before the end of the line that he lost his bearings. But knowing that he was near the end of the line, why had he not immediately requested the driver to slow down?

The signalling at Stavoren

There were no colour-light signals to indicate the end of the line at Stavoren, only three retro-reflective signs that would light up in the headlights of passing trains. However, this in itself was no different from the situation in places elsewhere in Europe. The normal procedure to indicate the end of a running line on many European networks would be to show a distant signal at caution, either as a yellow colour-light signal or as a retro-reflective board (e.g. showing the distant arm at caution – a fixed distant in British railway parlance) and then have the red signal or end-of-line sign mounted on top of, or just before, the stop blocks. Curiously, the situation was different at Stavoren, which warrants a little further explanation.

The signalling feature used at Stavoren was a set of three so-called 'keperbaak' boards, which were white vertical oblong boards with respectively three, two and one black chevrons as a countdown sequence, the last 'keperbaak' also having a white triangular board on top with a sort of Zorro Z-slash. The function of this set of boards was that of a distant signal, instructing the driver to brake to 40 km/h (25 mph) or less as necessary in order to be able to stop for the following red signal or for a stop board. The wording in the driver signalling manual alone points at some form of route knowledge being necessary to handle a train safely in the situation thus officially created.

The history of these 'baak' boards is interesting. In the days of steam, when the footplate crew on a locomotive were widely exposed to external noise because of the open cab, many nations (including Germany and The Netherlands) employed a distinct set of warning posts on the approach to a distant signal that covered an important stop signal. In The Netherlands each post consisted of two or three uprights situated as per the signals on the right-hand side in the direction of travel, parallel to the tracks, on which two or three yellow painted planks with black diagonal lines were fitted that rose diagonally from a lower level to a higher level in the direction of travel and were tilted towards the train. In The Netherlands three of these assemblies in a row, each 70 m (230 ft) apart, would have been provided, the point being that they attracted attention in the daytime but in the event of poor visibility would reflect the rolling noise of the train back into the cab on three occasions with a distinct hissing noise of rising pitch, making them as good as unmissable to a crew intent on locating distant signals.

After the final demise of the steam locomotive in The Netherlands in January 1958, when train drivers were no longer exposed to noise from outside as they were on the noble machines of old, these contraptions were increasingly changed to a set of three yellow-coloured normal boards with diagonal black lines but which nevertheless kept the old name of 'baak'. Furthermore, a white version of the boards, with chevrons replacing the diagonal lines, was introduced that instead of drawing attention to the approach of a distant signal actually replaced that signal and so saved considerably on expense. A drawback, however, was that the boards did not resemble anything to do with signalling. This may point to the reason why things went wrong here, these being the type installed at Stavoren, protected with an ATBNG balise, which, as explained earlier, was not compatible with the ATBEG-v (simplified) equipment of this rail grinding machine.

Stavoren is the only location along a line operated at higher speeds (100 km/h or 60 mph) with passenger traffic in the entire country were this signalling solution had been applied, the other four locations being found at the end of low-speed freight branch lines. The Dutch pilot driver, unfamiliar with the line and thus with the function of these three signs despite their presence in signalling section 4.3 of his handbook, overlooked them on his diagram and opted to go by the speed warning boards he was familiar with. These, however, had been removed from the lineside a few years ago, as they duplicated the speed instructions of the 'keperbaak' fixed distant signal boards that had been installed, but when the old diagrams were scanned into a computer database for easy amendment and publishing they were erroneously retained on the maps. No one thought it necessary to report this anomaly and have it changed, which is typical in a case of this kind of infrequently used literature.

Comment

A rather neat trap had been set up as a result of various unsafe situations running parallel with each other. But notice how many safety issues, each of which was capable of preventing the accident from happening or mitigating its impact, had to be bypassed before the situation developed as it did:

1. The Italian train driver, in the prevailing European signalling and signing circumstances, could not be expected to have relevant route and signalling knowledge in The Netherlands, especially such an unusual distant indication for the end of the line. The Dutch pilot, however, who had been contracted with the express purpose of assisting in running the train safely, had no useful local route knowledge either and had done very little to gain it to a sufficient extent. He thus managed to overlook the unusual distant indication.
2. His employers, aware of that assignment, took no action to ensure that the man was sufficiently well informed to do the job safely. It was neither the first nor the last time that an employer had shown a disregard for the use of route knowledge. However, steps to clarify route knowledge responsibilities were taken in the wake of this accident.
3. As with any meeting between different European nationals, it first had to be established which language would be used to communicate (not necessarily fluently). It turned out to be German, but it should be noted that English is designated the international lingua franca on the tracks. Things being as they are, however, the time when that is the case throughout Europe is probably still a long way off.
4. Despite the route-learning trip, the pilot driver was not familiar with the unique 'keperbaak' fixed distant signal boards at the end of this particular line. Ironically,

provision of a recognisable type of distant signal was something the Italian driver would in all likelihood have understood from experience and reacted to under his own initiative.

5. The official route diagram showed the ‘keperbaak’ boards but erroneously also showed a speed reduction warning board and a speed reduction section board that had been removed a number of years earlier. The document was also marked ‘Not to be used for safety-critical purposes’.
6. The pilot overlooked the indeed rather innocuous-looking keperbaak fixed distant boards whilst concentrating on locating the non-existent speed boards. His knowledge of signalling apparently did not stretch to telling him that any stop signal in The Netherlands (also the red board or light on a set of buffer stops) is preceded by some form of distant signal rather than by a speed warning. This omission in his knowledge prevented him from querying what he saw on the track diagram, or from looking it up in his copy of the handbook.
7. The local driver with whom he had scouted the route did not point out this unique signalling feature, nor the absence of the speed boards. The local drivers apparently had not considered this anomaly important enough to report to the national network provider to have it corrected on the track diagram. Familiarity breeding contempt.
8. ATP, having been installed at great cost on the train in one version (EG-v) and along the track in another version (NG), was fully switched out per design on leaving the ATBEG-protected area just past the junction with the Harlingen line, instead of going to partial supervision and so at least keeping the permitted speed to 40 km/h (25 mph). From then on neither system was of any use in preventing this high-speed accident.
9. At a crucial moment, when perhaps the situation could still have been saved or the violence with which it occurred could have been mitigated, the pilot allowed himself to get distracted and look back several times for prolonged periods. Thus he failed to notice either the ‘keperbaak’ distant signal boards or the last level crossing, and also missed the p-way people standing there attempting to gain his attention.

The 60-year-old pilot driver was initially charged with endangering rail traffic and potentially faced a year’s prison sentence if found guilty. His employer, Spoorflex, went bankrupt two weeks after the accident happened. In late 2014, however, it was decided not to prosecute the pilot driver as too many issues had been incorrectly dealt with when the companies involved had set up the job, and there had been too many faults with the maintenance of the indications along the track and the way they were presented to rail staff. According to the prosecuting authorities, the overall attention to safety had been seriously flawed.