Statens Havarikommisjon for Transport

REPORT

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This report is translated from Norwegian. The Norwegian text remains the official version of the report. Should ambiguity arise between the two the Norwegian text takes precedence.

This investigation has been of limited scope. For that reason, the AIBN has chosen to use a simplified report format. A full report is used only when the scope of the investigation makes this necessary. The simplified report highlights the findings made and puts forward potential safety-related recommendations.

Date and time:	Thursday 06 July 2006 at time 1505
Accident site:	Østfold line, km 77.5 at Råde station
Form of operation:	Remotely controlled
Safety system:	Automatic line block
Type of incident:	Derailment
Train type and number:	Freight train no. 45955
Operator:	Green Cargo AB
Transportation type:	Freight transport
Gross train weight:	432 tons + locomotive
Train length:	372 m
Brake group and percentage:	P, 432 ton braked weight
Weather conditions:	Air temperature approx 30 ^{o}C and intense sunshine
Light conditions:	Good
Track operating conditions:	Dry
People onboard:	1 locomotive driver
Injuries to persons:	None
Material damage:	Minor damage to wagons, extensive damage to approx 500 sleepers and two overhead conductor masts
Other damage:	
Locomotive driver:	
- Sex and age:	Man, aged 54
- Education:	Locomotive driver
- Experience:	26 years
Information sources:	Norwegian National Rail Administration, Green Cargo AB and the AIBN's own investigations

FACTUAL INFORMATION

Thursday 06 July 2006 at approximatly 1505, freight train 45955 passed through Råde station. Once the train had passed through the station area and emerged onto the line heading for Onsøy, the train's main line pressure and the electric power supply suddenly disappeared. The driver looked in the locomotive's mirror and saw that dust was blowing up around the train. Once the train had come to a halt, he ascertained that wagon nos. 5-7 and 9-10 in the train had derailed and were grounded in the middle of the trackway.

Derailment site
In the derailment area, the track curves gently to the right in the train's direction of travel. The trackway is virtually horizontal and the line passes through a flat agricultural area (see figure 1). It is a single-track line, powered by electricity and remotely controlled from the train control centre in Oslo. The maximum permitted speed at the derailment site is 95 km/h. There are no buildings in the immediate vicinity of the derailment area.


Figure 1:


Figure 2:

Damage
Relatively minor damage to the wagons was registered. Two overhead conductor masts had been hit by the wagons and bent, but the overhead conductor remained suspended. Approximately 500 concrete sleepers were either crushed or damaged, and had to be replaced.

The train
The train comprised Swedish-registered Rc4 locomotive no 1307 belonging to Green Cargo and, according to the train manifest, 12 Swedish-registered empty car transporter wagons, type Laaeilprs belonging to NordWaggon AB. Green Cargo's investigation into the incident disclosed that the train had one further empty Swedish-registered wagon, without this being stated in the train manifest. No irregularities were discovered in the composition of the train, wagons or load that could explain the derailment.

The locomotive driver estimates the train speed at the time of the derailment as being approximately 85 km/h. The locomotive was equipped with ATSS with a trip data recorder. The locomotive's recording equipment was secured by Green Cargo at the derailment site and handed over to EuroMaint at Sävenes on 07. July 2006. After that date, the data recording equipment disappeared.

Other trains
The last train that passed the site before the derailment was an Intercity train comprising type 73B rolling stock which passed the derailment site a little before time 1500. There were no irregularities reported from this train.

The track
In the derailment area, the track consists of S54 rails in 900-grade steel, BB 1985 concrete sleepers (unit sleeper), 60 cm sleeper interval and Panderol e-clip securing springs. The rails were laid during rail change-out in 1989/90. The AIBN has not obtained any information about neutral temperature or any recording of the track's position in relation to fixed survey reference points in conjunction with this rail change-out process. Later, two end welds were recorded in the area, on 05 May 2000 and 24 May 2000, respectively, where the neutral temperature was indicated as 21 ^{o}C; these too were without any details of any correction of track position in relation to fixed survey reference points.

The curve was tamped in autumn 2002 and in autumn 2003 because of poor vertical geometry (places with crushed ballast). No examination or adjustment of track position in relation to fixed survey reference points were recorded during these works. A survey wagon is run along the section twice a year (spring and autumn). The last run before the derailment was on 18 April 2006; no particular faults were reported. The survey results from the last 6 surveys show diminishing "K-numbers" (quality index) from 82 in October 2003 to 62 in April 2006.

There are no reports, records or experience to indicate that the curve at which the derailment occurred had previously been subject to buckling. The neighbouring curve (km 78.12-78.36), however, had problems with buckling in September 1997.

The track's status after the derailment (see figure 3 and 4) showed that there must have been very high compressive forces in the rails at the time of the derailment.


Figure 3:


Figure 4:

Weather conditions
On the day of the derailment, the weather was clear with intense sunshine and a local air temperature of above 30^{o} C. Maintenance teams from the National Rail Administration East Region stated that they were unable to touch the rails, and assumed that the rail temperature of the steel to be about 50-60 ^{o}C. The temperatures on previous days had also been high, cf data from the meteorology station at Rygge in Table 1.

Table 1: Meteorology data from Rygge. (Source: Meteorology Institute)

Date	24-hr period temp [^{o}C]	Min. temp [^{o}C]	Max. temp [^{o}C]	Max. wind [m/s]	Mean wind [m/s]
03.07.06	19.6	14.2	23.8	6.3	3.2
04.07.06	20.3	16.2	24.8	6.3	3.1
05.07.06	20.9	15.5	25.4	5.3	3.0
06.07.06	21.2	14.0	26.7	4.2	1.8

Ongoing works/Inspection of the track
In his report the freight train driver states that he observed 3 track workers beside the track just after he had passed through Råde station. Information from the National Rail Administration confirms that a work team was working on manual tamping of a double timber sleeper carrying an insulated joint. Apart from this, according to the National Rail Administration, no extra inspections of the track took place during this period of strong, persistent heat.

Other investigations into this incident
The incident has also been investigated by Green Cargo AB. The AIBN has received a report of their investigation and does not have any comments on it.

Regulations
The National Rail Administration's measures for avoiding buckling are contained in the Technical Regulations JD 500 series. In summary, the most important of these can be described as comprising:

- Fixing the trackway in relation to a network of fixed survey reference points: Fixed survey reference points (JD 530 Chap. 13).
- Neutralisation of the track with a neutral temperature of 21 +/- 3 ^{o}C (JD 531 Chap. 6).
- Requirements on keeping the track within given tolerances in relation to the fixed trackway in operation and during later track works (JD 532 Chap. 13 Sec. 4).
- Rules for ballast quality, ballast profile and compression to ensure sufficient resistance to lateral displacement (JD 532 Chap 13 Sec. 6 etc.).
- Rules for dealing with buckling when this is detected (JD 532 Chap 13 Appendix 13c)
- Precautions during track works and during periods of persistent intensely hot weather (JD 532 Chap. 13 Sec. 6.3)

References to the regulations are not exhaustive.

AIBN ASSESSMENTS

The AIBN assumes that the freight train's locomotive triggered buckling which then led to the derailing of the wagons. The fact that the buckling was triggered by a freight train may be linked to the composition of the train, with a relatively heavy locomotive at the front followed by lighter wagons. However, the train's composition was within the terms of the current regulations and the train was being driven in accordance with the rules.

The locomotive driver estimates the train speed at the time of the derailment as being approximatly 85 km/h. The AIBN has no reason to doubt this estimate, and it has also been confirmed by the National Rail Administration personnel, who were working in the vicinity. The fact that the train's trip recorder data was lost, during the period when readings were being taken, is unfortunate but not critical in this case. On the basis of this experience, the AIBN will take stricter control of the trip data recorder unit in conjunction with accidents.

To ensure that the passing of a normal train would be able to trigger a buckling, the compressive forces in the rails would have to be greater than provided for in the regulations, or the track's resistance to lateral displacements would have to be lower than provided for in the regulations, or combinations of this. The compressive forces in the rails due to the effects of temperature are assumed to be kept at an acceptable level through neutralisation of the track at a correct temperature and that the trackway is then kept within given tolerances from the situation during the neutralisation. In the current track area, the last documented neutralisation was undertaken in May 2000 without there being any documentation about the trackway to prove its relationship to the fixed survey reference points. The track was later tamped in autumn 2002 and autumn 2003, here too without any inspection of survey reference points.

The AIBN has not received any information describing the status of the ballast and substructure in the area of the derailment at the time the derailment occurred. The information that the track was tamped in 2002 and 2003 due to poor vertical geometry (places with crushed ballast) may indicate that there had been weaknesses in the area previously. The extent to which these were still extant is unknown, but can hardly be excluded. Neither can it be excluded that the work on manual tamping of a double timber sleeper had an effect on the track's side resistance, even though this intervention was of a limited extent.

On the date of the derailment, no measurements were made of the temperature of the rails in question, but the maintenance team estimates this as being 50-60 ^{o}C. The rules for track neutralisation are based on a maximum rail temperature of 55 ^{o}C. The extent to which the rail temperature at the relevant time exceeded the assumptions of the regulations cannot be determined with any certainty from this point in time. The AIBN wishes it to be noted that rail temperature ought to be measured routinely whenever any buckling is detected, also after derailment.

In the opinion of the AIBN, this derailment was due to a combination of:

- Probably an incorrect neutral temperature as a result of changed horizontal geometry for the track after neutralisation.
- Weakened resistance to lateral displacement as a result of general status and tamping of a double sleeper.
- Rail temperatures up to (and possibly above) the assumptions for the regulations.

The AIBN has noted that the rules for track correction in accordance with the fixed survey reference points do not appear to have been followed in the derailment area. In the commission's assessment, this means that the track's actual neutral temperature was no longer being checked in this area.

The AIBN has also noted that equipment that allows the rail's actual neutral temperature (the actual stresses in the track) to be (post-)inspected is not being used regularly by the National Rail Administration.

In another investigation (JB report no 2007/10), the AIBN also has detected circumstances indicating that the regulations for preventing buckling are not being adhered to as regards neutralisation and the control and inspection of the track's position in relation to the fixed survey reference points.

The fact that the regulation for keeping track alignment within the given tolerances is not being monitored, and that tamping is being carried out on double sleepers at a time of persistent intense heat and very high rail temperatures, may indicate that the organisation's awareness of the danger of

buckling has been too low. In this investigation, which has a limited scope, the AIBN has not undertaken any further investigations that can shed light on this.

However, the AIBN is informed that in spring 2007 a "buckling seminar" was arranged at the National Rail Administration, highlighting the problems of, the mechanisms behind and remedial measures for buckling.

SAFETY RECOMMENDATIONS

For this investigation, the AIBN has not provided any safety recommendations[1], but refers to safety recommendation JB no 2007/21T in JB Report 2007/10: which reads:

> *Safety recommendation JB no. 2007/21T*
>
> *The investigation has uncovered discrepancies between set regulations and actual performance both in the prevention and repair of buckling. It is recommended that Norway's National Railway Inspectorate should order the National Rail Administration to investigate whether there are any conditions in the regulations, methods, training, organisation or supply of resources that ought to be amended.*

[1] The investigation report was sent to Norway's Ministry of Transport and Communications which is taking the necessary action to ensure that due consideration is given to the safety recommendations (ref. Regulation 31 March 2006 no. 378 regarding public inquiries into railway accidents and serious railway incidents etc (the Railway Inquiry Regulation) § 16.