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: | Wednesday 26 July 2006 at time 1640 |
| Accident site: | Eidsvoll-Dombås line, km 339.700 between Dovre and Dombås |
| Form of operation: | Remotely controlled |
| Safety system: | Automatic line block |
| Type of incident: | Derailment |
| Train type and number: | Freight train no. 5718 |
| Operator: | CargoNet AS |
| Transportation type: | Freight transport |
| Gross train weight: | 571 tonns |
| Train length: | 422 m |
| Brake group and percentage: | P 80% |
| Weather conditions: | Air temperature approx 30 $^{o}$C and bright sunshine |
| Light conditions: | Good |
| Track operating conditions: | Dry |
| People onboard: | 1 locomotive driver |
| Injuries to persons: | None |
| Material damage: | Damage to 7 wagons. Several overhead conductor masts and approx 500 concrete sleepers were destroyed. |
| Other damage: | |
| Locomotive driver: | |
| - Sex and age: | Man, aged 46 |
| - Education: | Locomotive driver |
| - Experience: | 18 years as locomotive driver |
| Information sources: | CargoNet AS, the Norwegian National Rail Administration and the AIBN's own investigations |

## FACTUAL INFORMATION

On Wednesday, 26 July 2007 at time 1640, the front 7 wagons of freight train 5718 derailed between Dombås and Dovre stations on the Eidsvoll-Dombås line. The train was en route from Trondheim to Alnabru, and had left Dombås station when the locomotive driver noticed a strong sideways jolt in the locomotive and saw in the mirror that the first wagon had derailed. After the train had stopped at km 339.5, he ascertained that a total of 7 wagons had derailed.

*Derailment site*
At the derailment site, the railway line goes into a semi-cutting in a relatively steep southwest-facing hillside with relatively little vegetation. The track moves to the right in a horizontal curve in the train's direction of travel with a radius of 685 m and a 110 mm cant. At the accident site, the line has a gradient of 14.5 – 16 o/oo. The highest permitted speed for freight trains at the site is 80 km/h. Just before the derailment, the train crossed over a bridge (approx 4 m long) over a farm track. The nearest buildings are some farm buildings roughly 100-150 m from the line further down the hillside.

*Damage*
It was established that there had been serious material damage to the wagons; two containers had fallen off and were lying approximately 100 m from the track in a steep slope, while a third container was standing on its end. Several overhead conductor masts, rails and approx 500 concrete sleepers were destroyed.


*Figure 1:*


*Figure 2:*

*The train*
The derailed wagons were 5 (five) Norwegian-registered privately-owned car transportation wagons of varying types, and 2 (two) German-registered (AAE) container/semitrailer wagons leased by CargoNet AS. There were nothing found in the wagons or load that could have caused the derailment. The wagon numbers of the derailed wagons, and the train's other composition, are shown in Appendix 1 "R206: Freight wagon list for train drivers".

The locomotive's travel recorder registered the train's speed at around 83 km/h just prior to the derailment.

*Other trains*
The last train that passed the site before the derailment occurred was the north-bound freight train 5721 which passed the derailment site at time 1520. No irregularities were reported from this train.

*The track*
After the derailment, a lateral displacement was measured on the track, varying from 0 at km 339.846 increasing to 80 cm at km 339.790. Between km 339.780 and km 339.700 the track was completely destroyed by the derailed wagons. From km 339.700 to km 339.650 the side displacement diminished from 80 cm to 0. The displacement always went towards the inside of the curve, i.e. out towards the fill edge.

On Friday 21 July 2006 (5 days before the derailment) buckling was reported in the derailment area. The buckling was measured as having an arrow height error of 35 mm, with a length of 3 m. As a consequence of this, speed at the site was reduced to 20 km/h, and antennae were set out. However, the buckling was repaired early in the morning of Monday, 24 July. The track was manoeuvred to the outside of the curve, lifted a little at both ends of the bridge and tamped from km 339.973 to km 339.820 using a points and crossing tamping machine. After that, the speed restriction was lifted.

Buckling was also recorded in this area on other occasions such as 09 July 1999 and 04 July 2001. All cases have occurred in the vicinity of the bridge at km 339.57.

The track was "permanently fixed" in 1985 and was neutralised for this purpose. There are no confirmed details of any later neutralisations. The last survey wagon run before the derailment was carried out on 26 May 2006. No irregularities were recorded. The AIBN has not obtained any information about the track's position, surveyed in relation to fixed reference points before the derailment.

*Weather conditions*
On the day of the derailment, the weather was fine, with strong sunshine and a local air temperature of around 30 $^{o}$C. The two previous days had had rather lower temperatures, while days 3 - 5 before the derailment had temperature conditions approximately the same as those on the day of the derailment, cf. data from the meteorology station at Kjøremsgrende in table 1

| Date | Min. Temp. | Max. Temp. | Temp. at 1300 |
|---|---|---|---|
| 21. July 2006 | 10.2 | 26.5 | 24.0 |
| 22. July 2006 | 11.6 | 27.8 | 24.1 |
| 23. July 2006 | 10.5 | 26.8 | 25.0 |
| 24. July 2006 | 13.6 | 23.6 | 20.8 |
| 25. July 2006 | 11.7 | 22.9 | 20.7 |
| 26. July 2006 | 9.9 | 27.5 | 23.9 |

*Other investigations into this incident*
The incident has also been investigated by the Norwegian National Rail Administration Accident Commission and by an internal review group in the National Rail Administration - East Region, with consultancy assistance from Det Norske Veritas. The AIBN is familiar with the results of these investigations, and has, to a large extent, used the factual information gathered there as its starting point for this investigation.

*Regulations for dealing with buckling*
The National Rail Administration regulations for dealing with buckling can be found in the National Rail Administration's "Technical Regulations" (the JD 500 series), covering rules for design, building, inspection, performance of maintenance and fault correction. It appears, for example, that all-welded tracks should be neutralised at a temperature of between 18 and 24 $^{o}$C, and that the

neutralised track's position should be recorded and checked in relation to a reference system given at survey points (fixed reference points) along the track. The following quotation is from concrete regulations that were relevant to the current situation:

JD 532, Chapter 13 Item 6.2.2, Appendix 13.c Item 3 Prevention of Buckling:

*At locations where there has been buckling or a tendency to buckle, measures to improve safety ought to be assessed; for example whether the track ought to be neutralised again to reduce the danger of buckling. The neutral temperature ought then to be placed at the upper end of the neutral temperature range. In conjunction with the neutralisation, the track should be secured in accordance with [JD 530] Chap. 13.*

JD 532, Chapter 13 Item 6.3.1.1 Inspection at high temperatures:

*During periods of strong, persistent heat, and when track works are being carried out that weaken track stability, an extra examination must be carried out.*

1. *In addition, special inspection must be made of sharp bends on narrow embankments and sections which, as experience shows, are subject to buckling or a tendency to buckle.*
2. *The inspection should be held at the hottest time of day, or before any train is going to pass, and must not cease before the temperature is decreasing.*

JD 532, Chapter 13 Item 6.2.2, Appendix 13.c Item 1 Temporary repair:

*If there has been buckling, the rails must be cut and given an opportunity to expand so that the compressive forces are reduced. The cut location ought to be outside the buckling curve. The track is then manoeuvred back to its correct bed, the temporary joint is secured with lashing and callipers, and extra ballast brought in and compressed. The track geometry is checked in accordance with Chapter 13.*

JD 532, Chapter 13, Section 4.2 indicates permitted deviations from the track's theoretical position to 30 mm horizontally for curves with a radius of 500-750 m when the track is set out using fixed survey reference points. In addition, JD 532, Chapter 13, Item 6.3.2 states that track geometry must be checked after buckling has been repaired.

JD 532, Chapter 13, Section 6.2 mentions explicitly repair of buckling as one of the tasks that can, to a large extent, reduce the side resistance and adjustment standard of the track. After this type of work is carried out, the travel speed should be reduced to 40 km/h or less (JD 532. Chapter 13 Item 6.4.1 a).

The conditions for removing the speed restriction are contained in JD 532 Chapter 13 Section 6.1 which reads:

*After track works, the ballast must be consolidated before full speed is used. This can be done by using track stabilisers and ballast tampers.*

*The track is always regarded as being fully stabilised after the passing of 100,000 gross tonne (gt).*
*Use of a track stabiliser is regarded as equivalent to a traffic loading of 50,000 gt. This applies on condition that the track stabiliser is used every time packing is completed.*

*Use of a ballast tamper is regarded as being equivalent to a traffic load of 20,000 gt.*

## AIBN ASSESSMENTS

The AIBN assumes that the derailment took place as a result of buckling just south of the bridge at km 339.87. It is uncertain whether the buckling was provoked when the train passed, or if it had already occurred before that.

The derailment is assumed to be linked directly to the repair works carried out during the night between 23 and 24 July to repair the buckling reported on 21 July at 1500 because of the following:

- The compressive stresses because of the temperature in the rails were still (too) high since the track not had been cut and given the opportunity to expand.
- The track's resistance to transverse loads was weakened as a result of the manoeuvring and tamping that was undertaken.
- The speed in that area had been increased to normal line speed at the location without the ballast having been consolidated sufficiently.

In addition, the AIBN assumes that there was probably a lack of certainty as to what the actual neutral temperature was in the area before the derailment, since the last known neutralisation was said to date from 1985, and that control and inspection of the track's location in relation to the fixed survey reference points does not appear to have been carried out. In the experience of the AIBN, the National Rail Administration does not undertake regular surveys of actual neutral temperature for the track using the methods available.

The AIBN states that the method chosen for repairing the buckling observed on 21 July did not comply with the National Rail Administration's regulation JD 532 Chapter 13 Item 6.2.2 Appendix 13c. The selected method, involving manoeuvring to the outside of the curve, was not particularly suitable for increasing the neutral temperature at this place with the given curvature and the limitation in the form of a constraining point in the bridge at km 339.87. Not cutting the track and allowing it to expand will be explained by a lack of appropriately qualified personnel for this operation. In addition, it may be noted that the crew undertaking the repair worked at night, when the temperature was lower and the buckling barely visible. The repair crews had therefore not seen the buckling at its full magnitude.

The AIBN also states that, before this incident, there was a discrepancy between set regulations and the performance of the work, both as regards to preventive measures and corrective measures in conjunction with buckling. In another investigation (JB report no 2007/11), the AIBN has also 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. This may indicate that there is an insufficient level of awareness in the organisation concerning the danger of buckling, the measures in the regulations that contribute to keeping this under control and the way in which confirmed buckling should be dealt with.

The AIBN knows that in spring 2007 a "buckling seminar" was held at the National Rail Administration, which highlighted the problems of, the mechanisms behind and remedial measures for buckling. The AIBN also knows that the reports from the National Rail Administration and the internal review team in the East Region contained several proposals for measures that could be undertaken to avoid similar accidents in the future. The AIBN takes as its starting point the fact that these will be reviewed by the National Rail Administration, and that relevant measures will be undertaken as an element in the National Rail Administration's safety management procedure.

Permitted speed was raised to normal line speed at the site before the ballast had been consolidated sufficiently. The AIBN considers this to be unfortunate, and in conflict with the National Rail Administration's regulations. The very fact that this could take place may indicate that the procedures were not sufficiently well formalised when the speed restrictions were lifted. In this investigation, the AIBN has not gone any further into the division of responsibility and the procedures for this, but would recommend that the National Rail Administration itself should review whether its regulations and practice in this area are satisfactory.

## SAFETY RECOMMENDATIONS

The investigation of this railway accident has discovered two areas in which the AIBN considers it necessary to put forward safety recommendations with the purpose of improving railway safety.[1]

### 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.

### Safety recommendation JB no. 2007/22T

After a temporary repair of buckling, by manoeuvring the track to the outside of the curve, a temporary speed restriction at the site was lifted without the ballast having been consolidated sufficiently in relation to the National Rail Administration's regulations. It is recommended that the National Railways Inspectorate should order the National Rail Administration to assess whether the responsibilities and procedures for lifting temporary speed restrictions have been formalised sufficiently and put into practice as intended.

[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.

Appendix 1

R206-11-174021-1 CargoNet-GTS DATO: 26.07.2006

**GODSVOGNOPPTAK TIL TOGFØRER** KL: 12:54

Tognr.: 5718 Dato: 26.07.2006 Fra stasjon: TRONDH

| Type | Nummer | Innsett stasjon | Utsett stasjon | Trekkraft |
|---|---|---|---|---|
| Forspannlok. El14 | 142177 | TRONDHEIM | ALNABRU | 100 |

| Løpenr. | Vognnummer | S | Sendest. | Beststt. | Brutto | Brems | Aksler | P/G/A | Sth | Merknad | Utsettst. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 437629120035 | L | TRONDHEIM | DRAMMEN | 56 | 56 | 6 | P | 100 | 5 biler | ALNABRU |
| 2 | 437629101225 | T | TRONDHEIM | DRAMMEN | 33 | 33 | 4 | P | 100 | | ALNABRU |
| 3 | 437629101191 | T | TRONDHEIM | DRAMMEN | 33 | 33 | 4 | P | 100 | | ALNABRU |
| 4 | 437629101308 | L | TRONDHEIM | DRAMMEN | 35 | 35 | 4 | P | 100 | 2 biler | ALNABRU |
| 5 | 237642190084 | T | TRONDHEIM | LOENGA | 25 | 25 | 3 | P | 90 | | ALNABRU |
| 6 | 336849537673 | L | TRONDHEIM | ALNABRU | 39 | 39 | 6 | P | 100 | | ALNABRU |
| 7 | 336849566326 | L | TRONDHEIM | ALNABRU | 56 | 56 | 6 | P | 100 | | ALNABRU |
| 8 | 317649610001 | L | TRONDHEIM | ALNABRU | 48 | 48 | 6 | P | 100 | | ALNABRU |
| 9 | 336849551948 | L | TRONDHEIM | ALNABRU | 53 | 53 | 6 | P | 100 | | ALNABRU |
| 10 | 336849552003 | L | TRONDHEIM | ALNABRU | 67 | 67 | 6 | P | 100 | | ALNABRU |
| 11 | 427644323946 | L | TRONDHEIM | ALNABRU | 16 | 16 | 2 | P | 100 | | ALNABRU |
| 12 | 427644320835 | L | TRONDHEIM | ALNABRU | 20 | 20 | 2 | P | 100 | | ALNABRU |
| 13 | 336849537632 | L | TRONDHEIM | ALNABRU | 73 | 73 | 6 | P | 100 | | ALNABRU |
| 14 | 427644291242 | L | TRONDHEIM | ALNABRU | 17 | 17 | 2 | P | 100 | | ALNABRU |

| Lnr | Vogn/contnr | Farenr | UNNr | Varenavn og beskrivelse | NOS info | Fareseddel | Emb. gr. | Mengde |
|---|---|---|---|---|---|---|---|---|

**Bremset vekt for vognene er redusert med 15% for å øke sikkerhetsmarginen.**

| Bremse-prosent % | Bestemmende fall i promille o/oo | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| | Kjørehastighet i km/t | | | | | | | | | | | | | | | | | | | | | | | | | |
| 80 | 100 | 95 | 95 | 95 | 95 | 95 | 95 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 85 | 85 | 85 | 85 | 85 | 80 | 80 | 80 | 80 | 80 | 75 |

**TOTALT FOR TOGET**

Lengde (m) : 422
Antall aksler : 63
Brutto vekt (t) : 571
Bremset vekt (t) : 485
Bremseprosent : 80%
Bremsegruppe : P
Største hastighet : 90

**KVITTERINGSDEL**

Sluttsignal påsatt (kryss av) : ___

Kontroll av sammensetning (sign) : _____

Bremseprøve (sign) : _____