

REPORT

ROAD 2009/03



REPORT ON BUSINCIDENT ON RV3, NEVERDAL IN RENNEBU 7. NOVEMBER 2006

This report has been translated into English and published by the AIBN to facilitate access by international readers. As accurate as the translation might be, the original Norwegian text takes precedence as the report of reference.

The Accident Investigation Board has compiled this report for the sole purpose of improving road transport safety. The object of any investigation is to identify faults or discrepancies which may endanger road transport safety, whether or not these are causal factors in the accident, and to make safety recommendations. It is not the Board's task to apportion blame or liability. Use of this report for any other purpose than for road transport safety should be avoided.

Photos: AIBN

REPORT

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Submitted
date: 12.10.2009
ROAD Report: 2009/03

This investigation has had a limited scope, and for this reason, AIBN has chosen to use a simplified report format. A full report is used only when the scope of the investigation so dictates. The simplified report elucidates the findings made, and presents any safety-related recommendations.

Date and time:	7 November 2006 at 0915 hours
Accident location:	Neverdal in Rennebu Municipality, Sør-Trøndelag County
Road no., main section (MS), km:	National route (RV) 3, MS 01, km 0.070
Accident type:	Driving off the left side of the road in a right curve
Type of transport:	Passenger transport, requires license
Personal injuries:	Sixteen out of 41 on board injured, seven were sent to hospital and two of these had serious injuries
Road conditions:	Two-lane highway with centreline markings. Speed limit 80 km/h. Amount of traffic (YEARLY AVERAGE TRAFFIC LOAD PER DAY) approx. 1750 vehicles per day (2006).
Road conditions:	
- Road characteristics:	Right curve with a radius of approx. 250 m. Superelevation 6%.
- Operating conditions:	Strategy winter road. Division in the upkeep of road sections between various operators
- Contractor:	Kolo Veidekke AS (Gauldal/Oppdal in Sør-Trøndelag County) and Mesta AS (Nord-Østerdal in Hedmark County)
- Weather and driving conditions:	Clear skies, 3-4 degrees C, wet, icy road surface
Vehicle and cargo:	
- Type/combination:	Bus, vehicle group 213, cl. III
- Identity, manufacturer, specification:	BOVA-Furura type FHD 12, 1995 mod.
- Tyres	New summer tyres type Continental HSL, dimension 295/80R 22.5 on all wheels. Produced week 35/2006 in Slovakia. Tread depth measured at 14 mm.
- Damage to vehicle:	Extensive damage to the left of the front and along the entire left side.

- Load, type, amount, safety equipment:	Passenger transport, safety belts in the driver seat and four of the passenger seats
Road user:	
- Driver, gender and age:	Male driver, 43 years old. Polish nationality
- Driving licence classes:	ABCD. Driving licence class D (bus) acquired in 1999
- Driving experience:	Bus driver in Eastern Europe since 1999, not driven in Norway before
- Passengers:	Male passengers, 17-66 years old. Polish nationals.
Transport company:	BP i T " ALMATUR - CZĘSTOCHOWA " Sp. z o.o
Principal:	Bchtel International, Inc. (Norway Branch)
Planned route:	From Gdansk, Poland to Mosjøen, via ferry to Sweden
Information sources:	The police, Norwegian Public Roads Administration, Kolo Veidekke and witnesses

FACTS

The incident

On Sunday evening, 5 November, the bus started out from Gdansk, Poland with 37 Polish workers, bound for Mosjøen in Nordland County. Four drivers took turns driving. The last change of drivers before the accident took place on European Highway 6 (E6) at Kolomoen in Hedmark. From there, they chose to drive RV3 through Østerdalen, and after four hours were approaching the border to Sør-Trøndelag County.

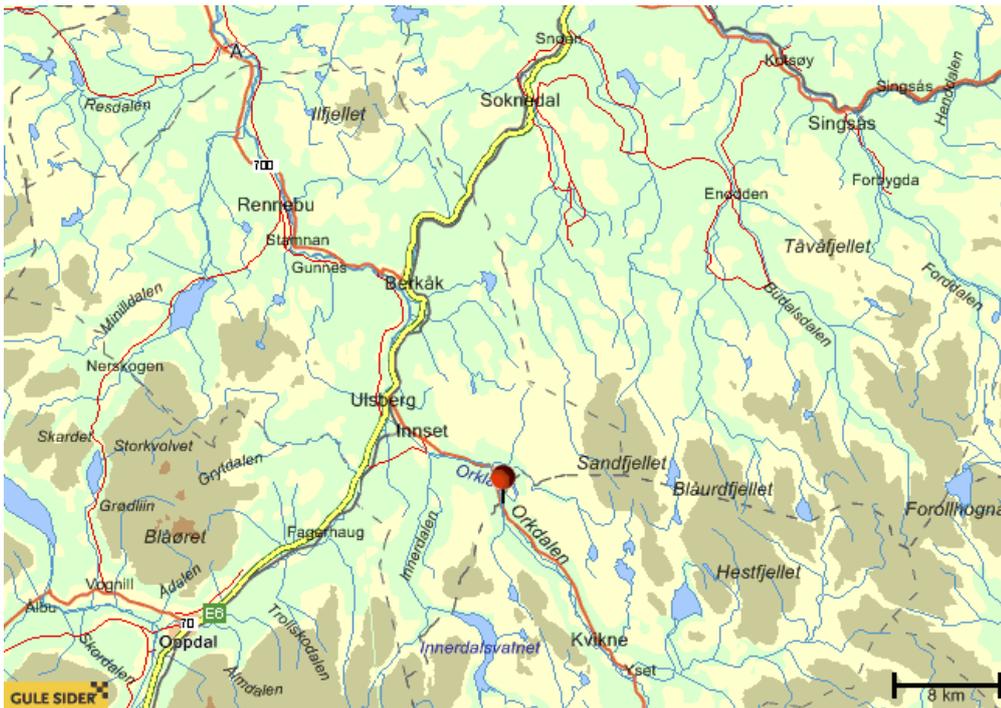


Figure 1: Map section with the accident site on the RV3 indicated.

The final section of RV3 in Hedmark County has a slightly sloping curvature in an open landscape. Where the RV3 crosses into Sør-Trøndelag County, the road enters a narrower right curve. At the start of the curve, the road crosses the Orkla river over the bridge at the Litlfossen waterfall. In this right curve, which has a minimum radius of approx. 250 metres, witnesses on board state that the bus lost its road grip before going off the road on the left side. Witnesses in the bus have estimated that the vehicle held a speed of approx. 80 km/h when entering the curve. Although AIBN has not

been given access to the bus's trip recorder's diagram disk, the estimated average speed over the last hours of driving and the estimated critical speed support the witness statements concerning the bus's speed into the curve. At the same time, the sand-spreader truck from the contractor on the Sør-Trøndelag side arrived at the county border in the opposite direction. The driver of the truck witnessed the incident and has explained that he saw the bus' s front wheels lose their grip and the bus went straight ahead in the curve.

The bus left the road approx. 18 m after passing the border into Sør-Trøndelag County. After exiting the road, the bus drove into the left-side ditch and turned over to the left against the side of the ditch embankment before stopping approx. 50 metres after leaving the road. The bus sustained damage to the front and along the left side.

According to the bus driver, witnesses and personnel from the Norwegian Public Roads Administration, there was a distinct change in the driving conditions at the county border at the time of the accident. The bus driver felt the road grip change suddenly, and he had no chance to avert going off the road, nor did he have time to apply the brakes. The topography also changes at the county border. On the Sør-Trøndelag side, the valley becomes narrower, and the road is characterised by narrower curves and shorter lines of sight. The Accident Investigation Board is acquainted with the fact that a Norwegian lorry truck drove off the road in a left curve approx. 1 km north of the county border earlier that same morning.

Three rescue helicopters, seven ambulances and the fire brigade in Kvikne and Rennebu were summoned, and at 1002 hours the police and the first ambulance unit from Oppdal arrived. Seven people were sent to hospital, two with serious injuries. The Rennebu Municipality crisis team was established, and set up a care facility in Rennebuhallen at Berkåk.



Figure 2: The bus where it ended up against the ditch embankment. Tracks from the bus's left rear wheels can be seen in the middle bottom of the picture. (Photo: The 330 Squadron, Ørland airbase)



Figure 3: The bus where it ended up in the ditch embankment. (Photo: The 330 Squadron, Ørland airbase)



Figure 4: Tracks on the edge of the road after the bus drove off the road, looking southwards into Hedmark County. The border stone can be seen to the right, in front of the police car. (Photo: Norwegian Public Roads Administration)



Figure 5: Damage to the bus after driving off the road. (Photo: Norwegian Public Roads Administration)

The driver's actions

The bus driver has stated that he started the driving in Poland on 5 November 2006 at about 2000 hours. Several drivers took turns driving, and there is nothing to indicate that driving and resting rules were not complied with. He has also explained that he rested and slept the eight hours on the ferry to Sweden. After that, he drove approx. four hours in Sweden, before taking over the wheel at the intersection between E6 and RV3 in Hedmark County. The plan was that he would continue driving until Trondheim. He says he experienced RV3 through Østerdalen as an ok road, but dark and curvy with a few icy sections.

A co-driver who kept a log of the journey has recorded the change of drivers to have taken place at a little over 0500 hours in the morning. The driver then had a break of about 20 minutes approx. 25 km before reaching the accident site. There is some uncertainty with regard to accurate times for the start and break, but the explanations from the driver and one passenger indicate that the bus was driven about three hours and ten minutes before the break. This indicates that an average speed was held which borders the speed limit on that stretch.

However, nothing indicates that the driver exceeded the speed limit of 80 km/h when the accident took place.

Tyres

The bus was equipped with new Continental HSL tyres with a relatively large knob pattern and a tread depth of about 14 mm on each wheel. These are summer tyres meant for long-distance driving. The Regulations relating to use of vehicles require the vehicle to have sufficient road grip in relation to surface conditions, if necessary by using winter tyres with or without studs, snow chains or similar¹.

In a Swedish study² from 2008, the friction characteristics of different bus tyres with regard to braking and steering were tested on even ice. Studded tyres achieved markedly better results in all tests than unstudded tyres. Bus tyre tests showed that unstudded, studdable winter tyres were not

¹ Section 1-4 of the Regulations of 25 January 1990 No. 92 (Regulations relating to use of vehicles). According to Section 13-1 of the Regulations of 4 October 1994 No. 918 (The Vehicle Regulations), winter tyres must be specially marked ("m+s" or similar) and have a tread depth ≥ 3 mm.

² M. Hjort, B. Thorslund, J. Sundström, M. Wiklund, G. Öberg (2008):

VTI Rapport nr. 618 "Bussars trafiksäkerhet vinterstid." (the traffic safety of buses in winter conditions)

better than summer tyres. Strongly siped winter tyres were somewhat better than unstudded, studdable winter tyres, but these were also not measurably better than summer tyres.

Bus tyres were also compared with regular car tyres (SUV tyres). Regular car tyres scored better than bus tyres in all tests. Unstudded winter tyres for regular cars achieved friction coefficients which were regularly 0.05 higher than for corresponding bus tyres. The Swedish study also shows that the friction is halved when unstudded bus tyres lose the road grip. For regular car tyres, the study found a reduction of friction with locked tyres or skidding, but not as markedly as for the bus tyres.

Road operation and management

The county border between Hedmark and Sør-Trøndelag counties is also the border between the management regions of the Norwegian Public Roads Administration, and accordingly also for the contract areas for operation and maintenance. The contractor Kolo Veidekke AS was responsible for operation and maintenance of RV3 on the Sør-Trøndelag County side through a functional contract for the period 2004-2008. Mesta AS was the responsible contractor on the Hedmark County side.

According to the report from Kolo Veidekke, the road north of the county border was salted sometime between 2100 and 0000 hours the night before the accident. Kolo Veidekke also states that the road was inspected between Ulsberg and Innset at 0500 hours on the day of the accident, and that they considered no measures to be necessary. The snowplough driver on duty was an employee of a Kolo Veidekke sub-contractor. When the snowplough driver reported the driving conditions to VTS (road traffic centre, region central Norway) as "bare and wet" between 0430 and 0600 hours, he was told by VTS that a report had come in on slippery conditions on the RV3 between the Hedmark County border and Ulsberg. This report was ignored by the sub-contractor, as the inspection they had just carried out indicated better driving conditions.

VTS had logged several callers at 0745 hours on the day of the accident who complained of slippery roads on the RV3 north of the county border. VTS then contacted the Clerk of Works responsible for the contract at the Norwegian Public Roads Administration. The Clerk of Works, who lived in the area, immediately drove out to inspect RV3. He found that the road was very slippery along the entire stretch of road, and from experience estimated the friction coefficient to be 0.15 or less. The temperature at the time hovered around zero degrees C.

The Clerk of Works found that conditions on the Hedmark County side were different. There, the contractor had sanded the road from the county border and southwards the preceding evening. He experienced the friction to be considerably better on the other side of the county border. This is also confirmed by Mesta, whose representatives inspected RV3 south of the county border at 0845 hours on the day of the accident, reporting good driving conditions. According to the topical folder for the Norwegian Public Roads Administration manual 111 "Standard for operations and maintenance", a sanded road with snow or ice cover can achieve friction up to 0.30.

During the inspection, the Clerk of Works contacted Kolo Veidekke, and was told that they were on their way with a salt truck following information from VTS at 0805 hours about more callers reporting slippery driving conditions on that stretch of road. The Clerk of Works met Kolo's salt truck at 0905 hours at Innset, north of the accident site.

The contract requirements for friction-improving measures were that they should be implemented within one hour when the friction coefficient fell below 0.30, and that sanding and salting should take place within two hours when the friction coefficient fell below 0.20. Based on the above, and

the fact that the first notification of slippery roads to Kolo was given before 0600 hours, the Norwegian Public Roads Administration has reacted by imposing financial sanctions for the contractor's breach of measure response time requirements and deficient internal notification routines.

The contractors have various aids at their disposal to help them make decisions about road measures. It is the driver on duty which normally assesses the need for measures. In addition to his/her own observations, weather reports and meteograms/weather data from climate stations are made available to the contractor. The closest stations are located at Oppdal, Berkåk and Kvikne.

The weather forecast in the meteogram from Kvikne, the station closest to the accident site, showed that air temperatures would be falling from about 4 °C at 0700 hours to – 4 °C at 0400 hours the following morning. In their report, the police has described the temperature to be + 5 °C at the accident site when they arrived. This shows that it was relatively warm at the time of the accident, and that temperatures were falling. The Clerk of Works also describes the air temperature as fluctuating.

In order to be able to interpret weather data and make correct decisions as regards the application of measures, the Norwegian Public Roads Administration requires that the contractor responsible for operation and maintenance participates in courses. Two persons, who are responsible for organising the winter operations of the contractor have purportedly attended a course in winter operations. The owner is responsible for holding the course, which lasts 2-5 days. The contractor shall furthermore ensure that the content is made known in the organisation and to any sub-contractors. Before the work starts, all personnel engaged in operations maintenance shall, as a minimum, have attended a 1-2-day course in snowploughing and sanding. The course shall be approved by the road owner. The Norwegian Public Roads Administration does not set any requirements for documented knowledge from the courses. Beyond this, no other competence than a truck driving license is required. The driver on duty for Kolo on the day of the accident started in that position in the autumn of 2006. He had no previous experience from winter operations work, nor any local knowledge of that stretch of road.

New contractual requirements

According to the Norwegian Public Roads Administration, the contract provisions from 2008 set more specific requirements for the plans which must be attached to the tender. The plans must show to what extent the contractor is able to fulfil the contract provisions, and this will form part of the assessment basis when choosing tenderer. In new contracts for operation and maintenance, the Norwegian Public Roads Administration also requires that the contractor introduces and maintains a quality system which complies with the requirements in NS-EN ISO 9001:2000. Among other things, the standard calls for continuous improvement, and requires improved documentation of both the assessments of the need for measures and any implemented measures. In the new contract for area 1604 Gauldal/Oppdal (2008-2013), the contractor has set requirements for assessments and implemented measures to be documented four times every 24 hours, and that measure assessments based on the aids available to the contractor shall be reported. In this connection, AIBN also refers to AIBN's RAPPORT VEI 2008/02, a topical report about three winter accidents which touch upon contractual issues in connection with winter operations.

THE ASSESSMENTS OF THE ACCIDENT INVESTIGATION BOARD

The course of events form the basis for assessing which factors contributed to the accident. The accident investigation board is of the opinion that the cause of the accident is that the interaction

between the driver/vehicle and the road failed. The bus driver's choice of speed and the bus's tyres were contributing factors, but AIBN believes that the greatest safety-related nonconformity and improvement potential can be found in connection with the sudden change in the road's friction characteristics at the border between Hedmark and Sør-Trøndelag counties.

AIBN considers the extent of the damage and injuries to be moderate due to favourable terrain on the side of road where the bus drove off. Most of the passenger seats were not equipped with safety belts, and the rescue effort was extensive and was given high priority. Due to the favourable conditions surrounding this accident, AIBN has not assessed the potential for improvements related to reduction of the extent of the damage and injuries in further detail.

The bus ended up on the left side of the road in a right curve on the border between two of the Norwegian Public Roads Administration's management areas, and therefore also on the border between contractors for operation and maintenance of the road. Different operational measures had been implemented on each side of the county border preceding the accident, and these measures resulted in substantially different road grip conditions according to the Clerk of Works and witnesses on the bus. The accident investigation board is of the opinion that the sudden change in friction conditions on the border between Hedmark and Sør-Trøndelag counties was a strongly contributing factor to the bus skidding and driving off the road, injuring 16 of the 41 people on board.

In addition, the county border constitutes a border both as regards topography and road standards. AIBN believes that the transition to sharper curves when coming from the south also contributed to the bus losing the road grip.

The contractor's driver on duty states that he checked parts of that stretch of road at 0500 hours, and considered there to be no need for measures. He maintained this assessment even if VTS central Norway communicated a complaint over slippery roads made at 0700 hours, and no measures were implemented. AIBN believes that it was unfortunate that the report of slippery road conditions from VTS was ignored and believes that the contractor's routines should have been clearer.

The accident investigation board is of the opinion that road operations which aim to ensure good and predictable driving conditions in the wintertime must be based on relevant and reliable information about the weather conditions. The person on duty is often alone in deciding which measures to implement, and in this case that person was in addition inexperienced. AIBN is of the opinion that this makes the winter operation vulnerable to erroneous assessments. The accident investigation board has no basis for claiming that the contractor's assessments were wrong based on the available weather data. However, it cannot be excluded that better competence in interpreting weather data could have yielded a different result. AIBN questions the competence requirements/level when interpreting weather condition information and using these data. Available weather data in connection with local conditions should be invaluable in such situations.

To follow up and quality assure the operation and maintenance work, the contractor's decisions and implemented measures should be verified. In AIBN's opinion, this would also be easier with more systematic and accurate use of weather data. In this context, the accident investigation board believes that it is positive that the Norwegian Public Roads Administration's new contracts require better documentation from the contractor of its evaluations and implemented winter operation measures.

AIBN has estimated the critical speed for avoiding skidding in the curve to be approx. 80 km/h, provided a friction coefficient of 0.15. With a friction coefficient of 0.10, the critical speed through

the curve will be reduced to approx. 70 km/h. The reduced friction when the bus loses its road grip means that it is hard to regain control of a vehicle once it has started skidding.

The Accident Investigation Board questions the friction characteristics of unstudded winter wheels for buses and other heavy vehicles in general and believes that it is no coincidence that heavy vehicles are the first to get into trouble when the road conditions become slippery. This is also confirmed in the Swedish study and is explained by the combination of the wheel load of heavy vehicles, strict requirements to rubber mix and load strength and limited effect from studs due to heavy wheel loads.

The tyres of the accident bus had a large knob pattern and a good tread pattern, but the friction characteristics were not good enough to handle the icy conditions in the curve. In this connection, AIBN refers to the Swedish study which shows that studdable winter tyres on buses without studs have no better road grip than summer tyres on icy roads. The tests were all carried out with friction values of less than 0.2. The tests demonstrated that buses with unstudded tyres achieved friction coefficients which were regularly 0.05 lower than similar winter tyres for regular cars under equal conditions. This is a marked difference within the relevant measuring range (0.1- 0.2).

The bus driver was not familiar with the area and was leaving an area with better friction conditions and less sharp curves. The driver had not adapted the speed sufficiently to the driving conditions on the other side of the county border. However, AIBN believes that the marked change in friction and curvature at the county border was unexpected and surprised the driver. The driver was probably within the speed limit, and it is the opinion of the Accident Investigation Board that it would have been difficult for the driver to predict the sudden changes in driving conditions.

The accident is an example of marked differences in the standards related to winter operations in adverse locations, placing too stringent demands on road users and vehicles. The Accident Investigation Board believes it is especially important to avoid changes in standards which are unnatural and difficult for road-users to predict, and believes there is a potential in coordinating or adapting the operation and management better on road sections which crosses administrative borders. To ensure more identical conditions, the Accident Investigation Board considers that the contract borders for operation and maintenance could be adapted to road sections in addition to geographical areas.

SAFETY RECOMMENDATIONS

The investigation of this road traffic accident has uncovered an area where the Accident Investigation Board considers it necessary to make a safety recommendation to improve traffic safety.³

Shortly after the accident, AIBN uncovered that a significant difference in standards had arisen at the border between Sør-Trøndelag and Hedmark counties as a result of differences in the implemented winter measures. Therefore, AIBN decided to issue the following immediate safety recommendation to the Norwegian Public Roads Administration in a letter dated 2 January 2007:

³ The investigation report will be submitted to the Ministry of Transport and Communications, which will implement the necessary measures to ensure that the safety recommendations are given proper consideration, cf. Section 14 of the Regulations of 30 June 2005 relating to public investigations and notification of traffic accidents, etc.

"The Accident Investigation Board Norway recommends that the Norwegian Public Roads Administration review the winter operation on RV3 south and north of the border between Hedmark and Sør-Trøndelag counties with the aim of avoiding differences in standards (Immediate safety recommendation VEI No. 07/4-1)."

On the basis of this safety recommendation from AIBN, the Directorate of Public Roads sent an internal memo (reference 2007/009060-001 dated 25 January 2007) to all Norwegian Public Roads Administration regions, in which the regions were reminded on a general basis that road operation shall be organised to avoid sudden and unexpected changes in driving conditions between regions, districts and contract areas. A request was also made, to the effect that that the choice of strategy and contract borders, as well as operational schemes for winter maintenance and other operational tasks should be coordinated across regional/district borders to avoid unnecessary differences in standards.

As a result of the memo from the Directorate of Public Roads, the Norwegian Public Roads Administration, Region Eastern Norway has given the contractor of functional contract 0405 Northern Østerdalen 2005-2010 instructions to coordinate the winter operations on RV3 across the contract borders. Corresponding instructions have been given to the contractor for adjacent contract areas to the north and south.

AIBN maintains the immediate safety recommendation, and makes no new recommendations on these issues.

Accident Investigation Board Norway
Lillestrøm, 12. October 2009

REFERENCES:

M. Hjort, B. Thorslund, J. Sundstrøm, M. Wiklund, G. Öberg (2008):
VTI Rapport nr. 618 ”Bussars trafiksäkerhet vinterstid.” (the traffic safety of buses in winter conditions)