



NOTE

Date 27-02-2024
Casenr. 2023-163

English translation of chapters 1. Report summary, 5. Conclusion and 7. Recommendations from the Danish report "2023-163 Redegørelse, Roskilde-Viby Sj, Sporbeliggenhedsfejl efter styret underboring (28-02-2023)"

A Horizontal Directional Drilling (HDD) created a vertical irregularity on the track and led to a risk of derailment. (28-02-2023).

1. Summary

When regional train 2233 passed kilometer (km) 39,817 on the track between Roskilde and Viby Sj. a vertical irregularity on the track led to a risk of derailment. The vertical irregularity had occurred as a result of a "blow-up" from a HDD. The blow-up probably happened because the drilling route passed by an unrecognized area with a newly established drainage pipe and previously excavated soil.

A supervisor who took part in the HDD had to monitor the railway while the drilling work took place. He had to intervene if a danger to the railway safety emerged in relation to the HDD, but he only noticed the vertical irregularity after train 2233 had passed.

The supervisor's training had not included matters about HDD. Experience from previous similar tasks led to the supervisor not considering the last part of the HDD with reaming and pulling of pipes the last meters as a risk to railway safety.



Foto 1. Right track, Roskilde - Viby Sj. Seen in direction towards Roskilde. Foto: Banedanmark.

5. Conclusion

When train 2233 passed the site of the HDD at km 39.817 between Roskilde and Viby Sj., a vertical irregularity of 55 millimeters (mm) for wavelengths $\lambda=25-70$ meters (m), and 19 mm for wavelengths $\lambda=3-25$ m, had emerged

The speed of the train at the passage was approx. 155 kilometers per hour (km/h) and this resulted in a risk of derailment.

The vertical irregularity was a result of a blow-up, where return fluid had forced its way out of the drilling and into a layer of soil below the tracks. This probably happened when the drilling passed close to an area where the soil layers had been excavated in connection with establishment of a drainage pipe along the west side of the track in 2022. The establishment of drainage pipe was not included in the risk assessment of the HDD project because the drainage was part of an overall track project which had not yet been completed. Therefore the geographical coincidence between the projects was not identified. As a result, adequate risk management could not be carried out.

The HDD project had identified a risk of a vertical irregularity, where the cause was elevation of the track as a result of blow-up. The risk was not quantified (stated as a measurable quantity that could be compared directly with the limit values in the regulations at hand (BN1-38-6, section 11.3.2)), and was therefore not included in the assessment of whether the HDD project should be carried out on tracks in operation, either with or without speed limit for the passing trains, or if the track should be closed.

As it was possible to carry out the HDD project without train speed limitations, according to regulations BN1-13-3 and BN1-38-6, a trained and authorized track expert/track technician should be present to monitor the tracks during the HDD (Supervisor). They should stop the work and possibly also the train operations, if deviations occurred that could affect railway safety. Thus, the danger was considered managed and the risk considered acceptable.

The supervisor whom was associated with the HDD project had undergone the training "Track Engineering part 1 and part 2" in 2017. The training at that time did not include conditions regarding the monitoring of tracks in operation in relation to HDD. The supervisor's understanding of risk was therefore solely based on their own prior experiences.

AIB Denmark assesses that the supervisor was of the opinion that there was no longer a danger to railway safety, when the reamer¹ was no longer working directly under the track, but instead approx. 20-30 m from the nearest rail, and the pull-through was almost complete. Therefore, he visually inspected the tracks one last time and then went up to the drilling machine.

With visual monitoring of tracks in operation in accordance with an HDD under the tracks, a supervisor would: 1. Have to be situated in safe distance to the tracks, and 2. Be able to react if a vertical irregularity as less as 3 mm occurred. AIB Denmark assesses that there is no guarantee that a human can detect small track irregularities at such a distance. Major track irregularities that would require an immediate stop of traffic could probably be observed, but there is no guarantee that the supervisor would be able in time to stop trains that were already on their way.

¹ A reamer is a drilling tool that expands the drilling to its final diameter, while pulling the final tubing into place in the full length of the HDD.

7. Recommendations

AIB-Denmark has made one recommendation:

Banedanmark's (Infrastructure manager) approval of the HDD in question was given on the basis of the risk management of the HDD that was described in the document "Sikkerhedspakke LED version 3.0".

Banedanmark did in the risk management - and thus in the approval of the HDD, not

- take the co-interfering over all track project Roskilde - Ringsted into consideration as a prerequisite for the risk assessment.
- state the danger of vertical irregularity, as a result of blow-up, as a measurable quantity (quantification) that could be compared directly with the limit values in the regulation BN1-38-6, section 11.3.2, with which sufficient traffic restrictions could be introduced.
- acknowledge that visual monitoring of the tracks in practice did not ensure that track irregularities could be identified and reported in time for traffic restrictions to be implemented, so that the risk caused by track irregularity was mitigated.

DK-2024 R1

AIB Denmark recommends that the Danish Transport Authority ensures that Banedanmark, through risk management of the activity Horizontal Directional Drilling, while taking human factors into account, introduces sufficient and effective proactive and/or reactive barriers to reduce the risk posed by track irregularities to an acceptable level.