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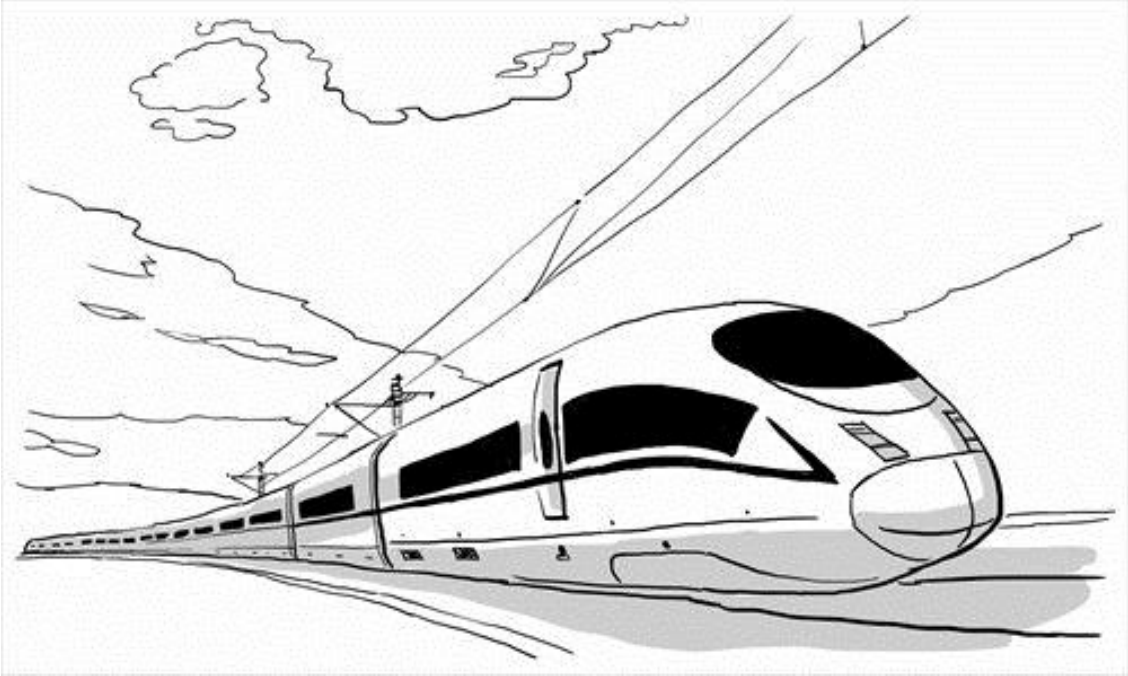

FINAL REPORT
Derailment of railway vehicles on the Knin-Zadar line
22 April 2014

Report publication and copyright protection

This report was prepared and published by the Air, Maritime and Railway Traffic Accidents Investigation Agency (hereinafter: the AIA) pursuant to Article 6, Paragraphs 1 and 4 of the Act establishing the Air, Maritime and Railway Traffic Accidents Investigation Agency (Official Gazette 54/13), Article 7, Paragraphs 1 and 4 of the Articles of Association of the Air, Maritime and Railway Traffic Accidents Investigation Agency, Article 115 of the Act on Safety and Interoperability of the Rail System (Official Gazette 82/13) and pursuant to Article 23 of the Directive 2004/49/EC of the European Parliament and of the Council (Railway Safety Directive).

Reading guide

All dimensions and velocities in this report are stated in the International System of Units (SI). All abbreviations and technical terms (*those written in italics appear in the report for the first time*) are explained in the glossary.

Descriptions and graphical presentations might be simplified in order to illustrate concepts for readers with no background in technology.

Preamble

The Air, Maritime and Railway Traffic Accidents Investigation Agency (AIA) was founded by the Act establishing the Air, Maritime and Railway Traffic Accidents Investigation Agency („Official Gazette“, number 54/2013) as a legal entity with public authorities. The founder of the Agency is the Republic of Croatia and the founding rights are implemented by the Government of the Republic of Croatia.

The Agency's method of operation is subject to special regulations, i.e. laws regulating air traffic, maritime affairs and safety and interoperability of railway traffic, i.e. regulations adopted for implementing them.

Department for Railway Traffic Accident Investigation is an autonomous and independent organizational unit of the AIA in charge of conducting professional work relating to the investigations of serious accidents and incidents in the railway traffic on the railway network in the Republic of Croatia. Investigations are conducted pursuant to the provisions of the Act on safety and interoperability of the rail system (OG 82/13) and Directive 2004/49/EC of the European Parliament and of the Council (Railway Safety Directive).

The AIA investigates all serious accidents in railway traffic, meaning all events that include train crashes or derailments that result in the death of at least one person or *severe injuries* of five or more persons or *extensive damage* to vehicles, railway infrastructure or environment, as well as any other similar accident with evident impact on the safety of the railway system or safety management.

The AIA may also investigate those accidents and incidents that might have led to serious accidents under slightly different circumstances, including technical breakdowns in the operation of structural subsystems or their integral parts.

The AIA conducts safety investigations for the purpose of preventing accidents and serious accidents, which includes collection and analysis of data, preparation of conclusions including the determination of cause and, when appropriate, preparation of safety recommendations in order to prevent accidents and incidents in the future and improve the safety in railway traffic.

The objective of investigations relating to safety is in no way the determination of culpability or responsibility.

Investigations are independent and separate from court or administrative proceedings and may not bring into question the determination of culpability or responsibility of individuals.

The final report may not be used as evidence in a court proceeding aimed at determining civil-law or criminal-law responsibility of individuals.

SADRŽAJ

1. SUMMARY

On 22/04/2014 around 3:00 p.m., in the course of special-purpose train's operation on the section of M606 line Zadar-Knin, between the train stations Kistanje and Knin, in the village of Oćestovo, the train crashed into rockfall and two vehicles from the train system derailed.

No-one was injured in the accident but there was material damage.

The Air, Maritime and Railway Traffic Accidents Investigation Agency has no safety recommendations in relation to this accident.

REPORT SUMMARY

On22 of April 2014 at around 15:00 hours, during trafficking of a Train for special purpose on railway section M606 Zadar-Knin, between stations Kistanje and Knin in the village Oćestovo, there was a collision of the Train with a landslide of rocks and slipping of two vehicles. In the Accident nobody was injured, but material damage was caused.
Air, Maritime and Railway Traffic Accidents Investigation Agency has no recommendations related to this accident.

2. EVENT DETAILS

2.1. Event description

On 22/4/2014 around 3 p.m., on the M606 Knin-Zadar line, at kilometre 5+700, there was a crash and derailment of special-purpose railway vehicles, which was a part of a special purpose train system. The vehicles in the train were coupled during the drive. The personnel and vehicles that were in this accident worked that day on repairing the M606 line. The repairs have been underway since 2012. The point of derailment was at the Oćestov stop.

The operator of the railway vehicle in the first railway vehicle, in the course of the drive from Kistanje to Knin, immediately after passing the stop Oćestovo, at the speed of about 30 km/h, hit a rockfall and the railway vehicle derailed as a result of the impact to the left side of the track in the travelling direction. The operators of railway vehicles in the third and fourth vehicle started breaking, each in their respective vehicle immediately after they noticed a jerk.

After the vehicles stopped, the first vehicle remained in the position under ca. 90° in relation to the track, and its front part skidded off onto the embankment and was left hanging on the slope, and the second vehicle (the trailer of the first railway vehicle) derailed with both axles to the left side in the direction of movement, while the third and the fourth vehicle stayed completely on the tracks.

The rock which the train hit slid down from the height of about ca. 100m above the track, and ca. 100m right of the line. While rolling down the hillside the rock passed through a stretch of grove, fell into a ditch next to the track, ca. 1.5 m below the top of the rail (GRT) and skipped the tracks and stopped in between sleepers and the elements of the fixed surface area of the Oćestovo stop.

Considerable material damage was done to the first and second vehicle but no-one was injured. Damage was also done to the line, where a great number of wooden sleepers was destroyed and damaged, as well as the rails, to a lesser extent.

The place scene was visited by police officers who examined it and, since there were no injured persons, there was no need for an emergency medical intervention or rescue teams. AIA investigators did not visit the scene. The details regarding the event were received from a joint investigating committee and the police and by taking statements from the participants in the event.

2.2. Scene of the accident

The accident took place about 100 meters behind the Oćestovo stop on the M606 line, at the km 5+700, in the direction of Knin.

Image 1 – scene of the accident map *(image source: Google maps)*

Image 2 –Scene of the accident with derailed vehicles *(image source: HŽ Infrastruktura d.o.o.)*

Image 3–the position of derailed vehicles after they stopped *(image source: HŽ Infrastruktura d.o.o.)*

On 22 April 2014 (Tuesday) the train in question passed the section of the Knin-Zadar line in the opposite direction in the morning of the same day when there was no rockfall on it.

Image 4–Line damage at the point of the rockfall *(image source: HŽ Infrastruktura d.o.o.)*

Image 5–Oćestovo stop *(image source: You tube)*

2.3. Event background

2.3.1. Parties and participants in the accident

Employees and railway vehicles of companies Pružne Građevine d.o.o., PP Remont Pruga d.o.o. took part in the accident and the line where the accident happened is operated by HŽ Infrastruktura d.o.o.

Participants in the accident:

- The operator of railway vehicle A – the operator of the first vehicle
- The operator of railway vehicle B – the operator of the third vehicle
- The operator of railway vehicle C – the operator of the fourth vehicle

2.3.2. Trains and train system

Four special-purpose railway vehicles were involved in this accident and they were operating as a special train. The first vehicle was „verge bucket“, brand Plasser&Theurer USP 3000C, licence plate 98 78 9533 1566-9, operated by the operator of railway vehicle A. Said vehicle does not have an overhead line, and was not included in the breaking system of other vehicles. „verge bucket“ had a service wagon carrying tools, number U- licence plate 44 78 915 3562-0, connected to it and it, in turn, had a service motor-driven machine „TMD“ attached to it, licence plate 98 78 911 0562-7, operated by the operator of railway vehicle B, and it, in turn, had attached to it a service „tamping“ machine, licence plate 98 78 951 3563-8 operated by the operator of railway vehicle C. The operators of railway vehicles B and C each operated their brakes separately.

Before the train left the work site for Knin, the brakes were checked and the operator of railway vehicle A got a special written order from the train despatcher at the Kistanje station to drive within the speed limit

of 30 km/h, pursuant to Article 6 of the Instruction 52 of the Croatian Railways (Instructions on technical norms and data for the preparation and execution of the train timetable).

All motor vehicles had installed devices for recording driving parameters (tachograph).

2.3.3. Description of infrastructure and signalling system

Line M606 Zadar-Knin, where the accident happened is a single-track non-powered line belonging to the category of *International traffic railway line*, subcategory *Other railway lines for international traffic*, 95 km long, built in 1967. In 2012, the repairs of this line started along a stretch of 81 km with complete replacement of the track grid. The section of the line at the Oćestovo stop was executed in a right curve, facing in the direction from Zadar to Knin. There are signalling- relay devices installed on the line. The communication related to the regulation of train traffic between stations Knin and Kistanje is done via a telephone line connected to the device for digital speech recording. The train traffic takes place in station's intervals. No factors have been found related to the signalling devices, which could have contributed to this accident.

The manager of the regional unit Infrastructure Manager sent a written communication that said section of the line was checked on daily basis by the security patrol.

2.3.4. Means of communication

The means of communication between the personnel who were involved in the accident was enabled by the use of „Motorola" handheld transceivers and mobile phones. No factors have been found regarding communication means, which might have contributed to this accident.

2.3.5. Works performed at or close to the scene

Track repair works are being executed on the line M606 Knin-Zadar with complete replacement of the track grid, and this work precisely was executed by the participants in this accident and the vehicles involved in the accident. The work site is a few kilometres away from the scene of the accident and had nothing to do with this accident.

2.3.6. Initiating emergency plan for public rescue teams, police and health services and the related course of events.

The dispatcher of HŽ Infrastruktura d.o.o. from Knin notified the head of the shift at the Police Station of Knin about the incident by phone. Immediately upon notification, police officers visited the scene and examined it.

2.4. Dead, injured and material damage

2.4.1. Dead and injured

There were no dead or injured persons in this accident.

2.4.2. Cargo, luggage and other assets

Vehicles involved in this accident did not carry cargo, luggage or other assets.

2.4.3. Vehicles, infrastructure and environment

Extensive damage was done to the "verge bucket" and the wagon.

35 wooden sleepers were damaged and destroyed on the line and the tracks were damage as well.

2.5. External factors

The weather at the scene and during the event was favourable, the temperature was 17°C, and the sky was clear.

For the purpose of this investigation, company "Geo-Meteo" was asked to prepare an analysis of the weather conditions at the scene in the period of several days before the very accident. The weather analysis shows that on the wider area around the scene between 20 and 40 l of rain per square metre fell in the past 39 hours, representing a relatively large amount of precipitation in such a short time span. Rockfall is most frequently caused by the impact of profuse precipitation.

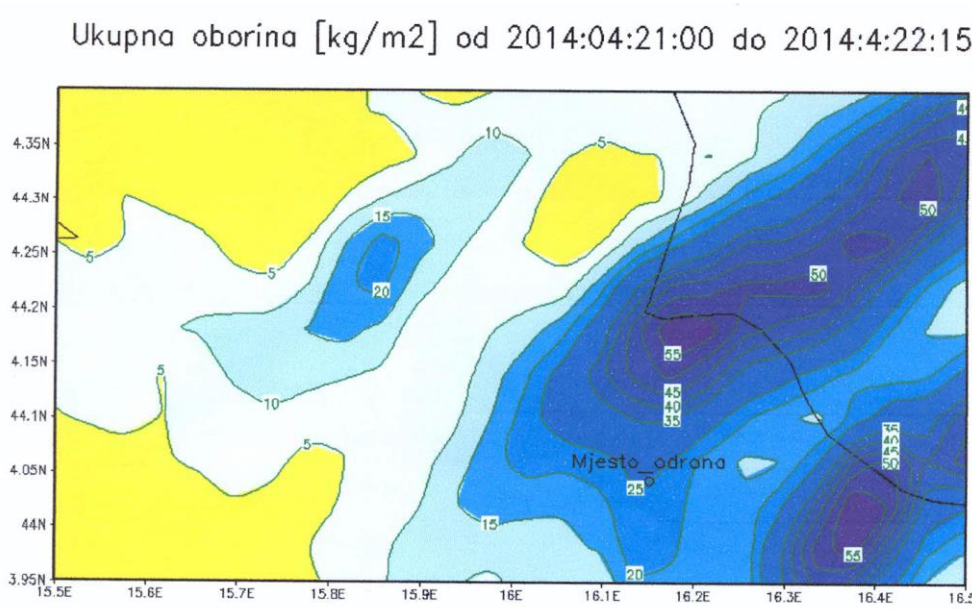

Image 6 – Accumulated amount of precipitation at the rockfall site *(Source: Meteorological report for the railway accident, prepared by Geo-Meteo).*

3. NOTES ON INVESTIGATION AND ANALYSES

3.1. Summary of witnesses' statements

The operator of the railway vehicle A stated that all service machines had their engines running and that they were moving at the speed of about 30 km/h. Passing by Oćestovo stop, he felt at one moment that the service machine he was operating rose up and derailed, it skidded off down the slope on the right side, facing the direction in which it was moving, where it stopped. The operator of the railway vehicle A stated that he had not noticed any obstacles on the road.

The operator of the railway vehicle B stated that all vehicles were coupled together into a group and that all three operators of railway vehicles operated service motor-driven machines in a coordinated way. When passing by the Oćestovo stop he noticed that the service wagon in front of him had the yellow lights turned on signalling him to start applying brakes, which he did right away. The operator of the railway vehicle B stated that he couldn't see the line from the service wagon that was coupled in front of him and that he only listened to the communication line used by the operators of railway vehicles and monitored the yellow lights on the wagon.

The operator of the railway vehicle C stated that all vehicles were coupled together one after the other and that all three operators of railway vehicles operated railway vehicles in which they were located and that they were moving at the speed of about 30 km/h. When passing by the Oćestovo stop he heard the operator of railway vehicle B shout „stop!“ , he saw a cloud of dust and immediately started applying brakes and stopped. The operator of the railway vehicle C stated that he was in shock and didn't know himself what had happened nor how the first service machine and the service wagon derailed.

The train in question already passed through the said section of that line on that same morning in the opposite direction (from Knin to Kistanje) when there was no rockfall on it.

There were no other witnesses.

3.2. Safety management system

Company Pružne Građevine d.o.o. does not have a safety management system in place since it is not registered as a railway operator.

From the Head of the regional unit Infrastructure Manager we received information that the section of the line in question was being regularly inspected according to the following schedule:

- Security checks the section on a daily basis from Monday to Friday
- The Head of the Supervisory Group Zadar or his assistant do it once a month
- The officer of the Supervisory head office checks it once a month.

3.3. Rules and regulations

Company Pružne Građevine d.o.o. carries out procedures according to rulebooks and regulations issued by the Manager of railway infrastructure, HŽ Infrastruktura d.o.o., and the signing of a Contract in application and cooperation is expected for the use of the Manager's safety management system, as well as the inclusion of the traffic activity of Pružne građevine into the system of HŽ Infrastruktura.

The greatest allowed speed of the said train of 30km/h was determined according to the Instruction 52 of HŽ (Instructions on technical norms and data for the preparation and execution of the train timetable).

3.3.1 Method of operation of railway vehicles and technical equipment

Railway service vehicles were coupled together into a train using coupling devices but the first vehicle doesn't have an overhead line and was not included in the joint air brake system. The brakes of other service machines were operated by the operators of railway vehicles.

3.4. Man-machine-organization interface

The working hours of all operators involved in this accident were in accordance with the Law, more precisely they had full three days off before the accident.

All operators involved in this accident had valid health certificates confirming their capacity to do work under special working conditions.

All operators involved in this accident had valid certificates confirming they passed the licensing exam for railway vehicle operators.

3.5. Prior similar events

The security of the regional unit of the Infrastructure Manager has not registered any rockfall on said section in the past two years.

4. ANALYSES AND CONCLUSIONS

4.1. Final presentation of the course of events, including conclusions about the event based on the facts from Article 3.

The said train passed the same section of the Knin-Zadar line on 22 April 2014 (Tuesday) in the morning of the same day in the opposite direction when there was no rockfall on it. On the way back from the work site to the station Knin, while passing by the railway stop Oćestovo, the train hit a rockfall, which was followed by the derailment of the first two vehicles. Nobody way injured in the accident.

4.2. Analysis of facts with the purpose of draft conclusion on the causes of the event

A day and a half before the rockfall the scene was under relatively strong precipitation, I the form of rain.

Everyone involved in the event worked within the allowed working hours with enough days of rest. The breath test showed that those involved in the event were not under the influence of alcohol.

The said section of the line is regularly controlled by the security of infrastructure Manager. They have not recorded any rockfall in the past two years.

A brake test was performed on the train before leaving the work site for Knin. Train speed on the entire section was limited to 30 km/h.

4.3. Conclusions

The direct cause of this accident was the crash of the railway vehicle with the rockfall on the tracks, which led to a derailment of two railway vehicles, which occurred due to the following causes:

Contributing factors of this accident were:

- Copious precipitation at the site of rockfall the day before the accident
- Poor long-distance visibility at the Oćestovo stop

5. MEASURES TAKEN

After the accident, the police examined the site and interviewed the persons involved in the accident.

Infrastructure operator set up a local investigating committee.

6. SAFETY RECOMMENDATIONS

The Air, Maritime and Railway Traffic Accidents Investigation Agency has no safety recommendations for this accident.