GISAF
Gabinete de Investigação de Segurança e de Acidentes Ferroviários
Office for the Investigation of Rail Safety and Accidents - NIB PT

Accident with passenger at Algueirão-Mem Martins, on 10/11/2014

INVESTIGATION REPORT

- English extended summary -

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Reader guide

All dimensions in this report are given using the International System of Units (SI Units). Where the normal railway practice uses non standard units, these are mentioned in the report with the corresponding SI Unit is also given.

Descriptions and figures may be simplified in order illustrate concepts to non technical readers.

Preface

The *Gabinete de Investigação de Segurança e de Acidentes Ferroviários (GISAF)* / Office for the Investigation of Rail Safety and Accidents, is the Portuguese State national investigation body that conducts independent investigations into rail transportation accidents and incidents in the country.

GISAF investigates all serious accidents. According to Portuguese Law, a serious accident means any collision of trains or derailment, resulting in the death of at least one person or serious injuries to five or more persons or extensive damage to rolling stock, the infrastructure or the environment, and any other similar accident with an obvious impact on railway safety regulation or the management of safety.

GISAF may also investigate and report on accidents and incidents which under slightly different conditions might have led to a serious accident.

The purpose of GISAF investigations is to make safety recommendations, based on the findings of investigations, in order to prevent accidents and incidents in the future and improve railway safety.

An investigation conducted by GISAF (including its scope, methods, conclusions and recommendations) is independent of all other investigations, including those by the safety authority or railway industry.

Investigations are carried out in accordance with Decree-Law 394/2007, as modified by Decree-Law 151/2014, transposing the Railway Safety Directive 2004/49/EC.

It is not the purpose of such an investigation to establish blame or liability.

Accordingly, it is inappropriate that GISAF reports should be used to assign fault or blame, or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

Personal data of involved persons is protected during the investigation and in the report.

This document is an extended summary of the investigation in English language, intended to allow the international reader easy access to the facts of the accident/incident and to the investigation findings, conclusions and recommendations. In this way it is hoped to help disseminate internationally any relevant safety information.

Due to the effort involved, it is not possible to provide a full English translation of the investigation report.

Any party interested in further information regarding the facts or the analysis of the investigation is invited to refer to the original report in Portuguese or to contact GISAF.

<u>Important notice</u>:

The English text of this document is given in good faith and "as is", to the best of the writer's knowledge. However, only the original report in Portuguese is binding.

GISAF cannot accept any responsibility for any error in translation or misinterpretation of the present document.

1. THE OCCURRENCE

On the 10th November 2014, around 19h11m, commuter train 18807, composed of two EMUs totaling eight vehicles, stopped at Algueirão-Mem Martins halt (Lisboa to Sintra line, at km 23 [1]) about 30 metres short of its designated stopping point, leaving the last four doors of the train outside the platform.

Figure 1: Accident location

As soon as the train stopped, a visually impaired passenger, pressed the handle for opening the automatic door where he stood, which was the first one outside the platform. The door opened and he stepped out, falling into the cess from a height of about 1,50 metres. The fall caused the passenger minor injuries and difficulties in breathing.

The accident was seen by the train guard, who requested help through his cell phone. After the agent staffing the halt arrived at the location and took charge of the situation, the train departed.

The emergency services attended the accident location shortly afterwards but were expecting a passenger fallen at the platform. After realizing the victim was at the cess on plain line, additional emergency services were requested so as to help bring him to the platform.

[1] Distance from Lisboa-Rossio terminal station.

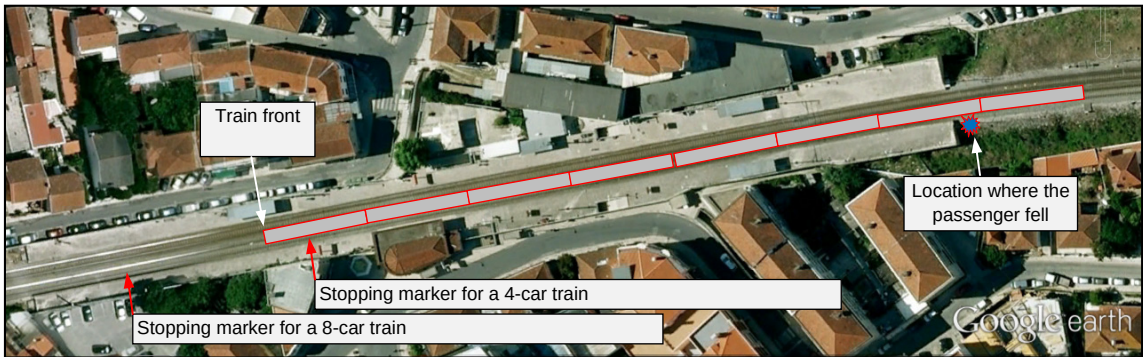


Figure 2: Reconstitution of the stopped train when the accident occurred

While the rescuers were at the cess delivering first aid to the victim, one train following the one where the accident happened approached and, after stopping and agreements were made on site between staff, went through with the rescuers and victim at the cess of the track.

The victim was then raised to the platform, further stabilized and transported to the hospital.

2. ORGANIZATIONS INVOLVED

The infrastructure and traffic control are managed by the Infrastructure Manager (IM) IP - Infraestruturas de Portugal, SA [2].

The trains were operated by the Railway Undertaking (RU) CP - Comboios de Portugal, EPE, who also employed the drivers, train guard and the agent staffing the halt.

3. THE TRAIN INVOLVED

The train involved was composed of two 4-car EMUs, class 2300/2400, build in 1992-1995 by former Portuguese manufacturer Sorefame in a consortium with Siemens A.G.. They were specifically designed for commuter service on the Lisboa-Sintra line and are now used on all Lisboa suburban lines electrified with 25 kV – 50Hz.

4. THE INVESTIGATION

The investigation looked not only into the accident itself, but also at the safety incident during the rescue operations. In this summary, these are treated separately from now on.

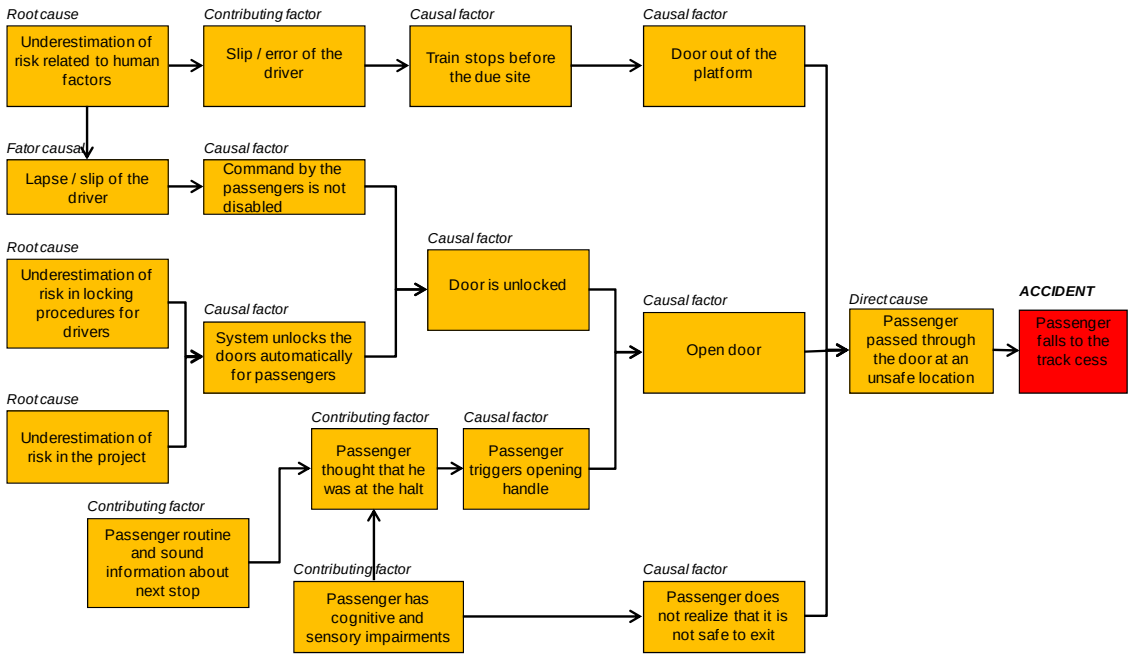
[2] At the time of the accident named REFER – Rede Ferroviária Nacional, EPE.

5. MAIN FINDINGS AND CAUSAL TREES

5.1. Accident with passenger

- The automatic door command system of EMUs class 2300/2400 is not designed in an intrinsically safe logic;
- Safety against the opening of doors at an unsafe location, with the train at a speed below 5 km/h, relies exclusively on a deliberate action of the driver;
- The train driver, for a number of reasons, may not be in a condition to make the required action to ensure safety, either by physical or cognitive incapacity;
- There is no safeguard built into the door command system against human failure;
- The RU hasn't made any risk analysis to the door command system of EMUs class 2300/2400;
- The risk of doors opening at an unsafe location is internationally identified, is relevant and can have serious consequences to passengers;
- This logic of door command system (also present on other EMUs in Portugal), is contrary to the general practice on rolling stock with automatically powered doors, whether in Portugal or abroad, regardless of building date or design origin;
- The stopping of the train short of the designated place, being a causal factor to the accident, is not determinant as the same result could have happened from any stop on plain line;
- The investigations carried out by the train operating company to similar occurrences in the past were not carried out in a way conducting to the identification and control of the existing risks to passengers, as far as reasonable.

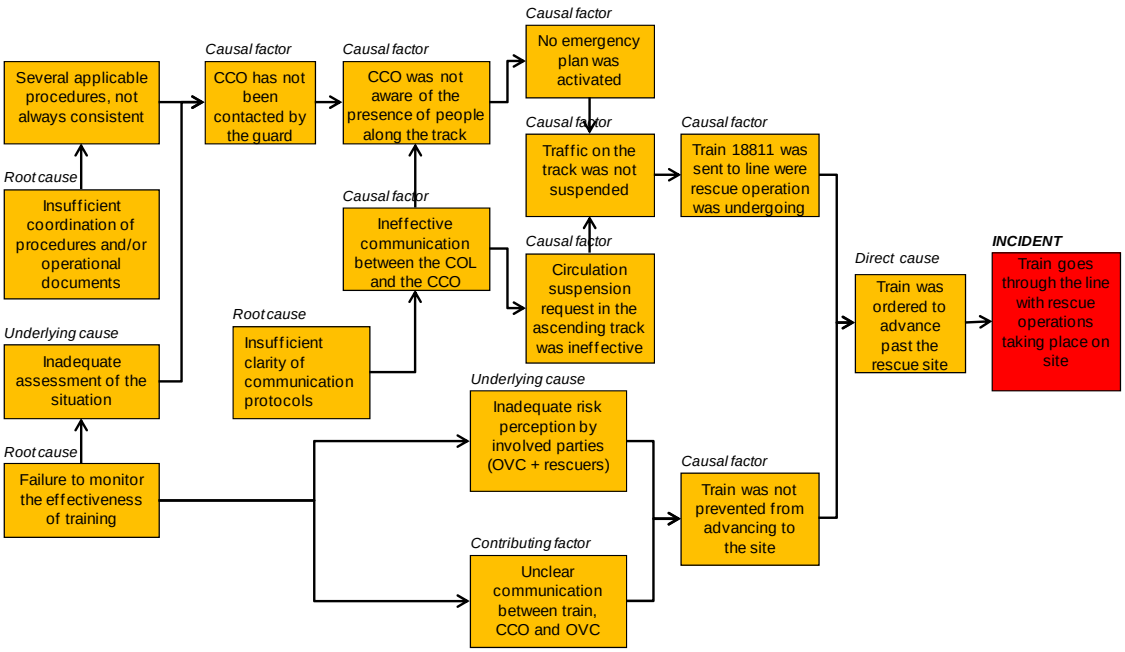
Accident causal tree



5.2. Safety incident during the rescue operation

- The type of accident, according to regulations, was not identified by the intervening agents, this leading to the applicable procedures not being followed;
- The accident was treated as a passenger falling on the platform and not as a passenger falling to the track;
- Successive lack of information clarity during the communications between several parties led to the fact that the occurrence was not correctly perceived by the command centres, and the procedures not being adopted – emergency status and traffic suspension on the affected section of line;
- By this same reason, rescue was delayed;
- The risk associated with a train passing on the track with rescue operations being carried out on the cess was not sufficiently perceived by the involved staff, subjecting themselves to unnecessary risks;
- There is no evidence that the training given by the RU to its staff relating to procedures during accidents, is adequate to give them proficiency in applying those procedures;
- The staff involved considers that the rescue operations worked normally and that, on similar circumstances, would take the same actions, an evidence which might imply that the established procedures, in this specific issue, may not be in full accordance with reality and the natural instinct of the users.

Causal tree for safety incident during rescue operations



6. INVESTIGATION MAIN CONCLUSIONS

6.1. Accident with passenger

The outstanding conclusion from the investigation is that the command control system for the train's powered doors didn't prevent a passenger from being able to open them normally, when it was unsafe to do so.

By that reason, being sensorially impaired the passenger was not able to perceive the danger and, led by the whole travel experience to a conviction that the train had normally stopped at the designated halt, stepped out of the door, falling to the void and landing on the cess.

On the involved rolling stock, the possibility of passengers normally commanding the power doors to open must be disabled by the train driver pressing an appropriate button, when the train is about to stop and it is unsafe for the doors to open. If this action is not performed, the doors will remain free to be opened by the passengers, therefore, in an unsafe state, regardless of the situation or location.

This logic is not fail-safe and is contrary to the general practice on rolling stock with automatically powered doors, whether in Portugal or abroad, where doors are normally kept by default in a safe state and an action by a member of the train crew is required to release the doors to be opened by the passengers, after assurance is sought that it is safe to do so.

The investigation observed that the RU hasn't made any risk analysis to the door command system of EMUs class 2300/2400.

The investigation determined that after train 18807 having stopped partially outside the platform, the possibility of the doors being opened by the passengers was not disabled.

The investigation could not determine exactly the reason why the doors were not disabled. It was determined that this was not caused by a technical failure so, necessarily, the reason must lay in human factors on the part of the driving function.

The RU didn't perform a risk assessment for failure of driver, the only safety element within the command system to prevent an unsafe opening of the doors. The risk associated with human failure in the door command system is not mitigated and passenger safety regarding door opening at unsafe locations is not guaranteed as far as reasonable.

On the other hand, existing no technical reasons for the train having stopped short of its designated location, this must also have resulted from human factors.

There is no evidence that the driver was under a state of fatigue due to working hours or regime. However, there is also no evidence that the RU has in force a system to effectively monitor the drivers' human factors that may negatively influence their performance and behaviour, in order as to act preventively. Therefore, the risk associated with human factors on driver performance is not effectively mitigated,

which is especially relevant when the involved rolling stock relies exclusively on driver action to control the risk of unsafe opening of the doors.

Although the fact of the train stopping short of the station is a causal factor for the accident, the train could have stopped for legitimate reasons at any other point on plain line, even due to a driver condition where he was physically incapacitated to disable the automatic release of the doors for passengers' control, leaving them free for opening at an unsafe location. In this situation a similar accident could have happened.

The fact that the passenger has sensorial impairments is also a causal factor to the accident. However, numerous passengers may have more or less permanent limitations in their ability to perceive the danger of doors opening at an unsafe location, e.g. children and elderly people.

Also, the investigations conducted by the RU to previous similar occurrences were not able to identify the risks involved in the door command system or on the opening of doors at an unsafe location. Therefore, evidence shows that the RU's SMS is not appropriate in what regards the treatment and learning from this type of incidents and accidents.

The fact that the system relies on an action by the driver for a safety essential function is a risk factor for which there is no evidence that any evaluation was made, and is not mitigated. This is particularly relevant when the risk for error may be enhanced by the operation pattern of the trains at the time of the accident, varying frequently in length from 4 to 8-car EMUs, the potential safety implications of which were themselves not the subject of any risk analysis.

6.2. Safety incident during the rescue operation

After the accident with the passenger, although rescue was quickly requested, there was a misclassification of the occurrence in what relates to procedures definitions.

The accident was treated as a passenger falling on the platform and not as a passenger falling to the track.

Because of this, the IM Operational Command Centre was not immediately informed of the fall to the track and the applicable emergency procedures were not established. Thus traffic on the track where the rescue was to take place was not suspended.

At the time of the accident, there existed four sets of procedures susceptible to being applied to accidents with passengers, a fact that may have contributed to the misinterpretation.

Also, evidence seems to show that during the whole occurrence, communication between intervenient staff was not clear or clearly understood as to the effective place where the passenger had fallen.

Even the emergency services were not aware that they had been requested for a passenger lying on the track cess, expecting instead a passenger fallen on the platform.

The analysis made by GISAF led to the conclusion that a request specifically made by the rescuers to the agent staffing the halt for the traffic being stopped was not clearly understood by the RU Operations Centre or by the IM Operational Command Centre, nor that the issuer of the request was made certain that the request was understood and taken into effect.

As a result, the emergency plan was never implemented nor was running suspended on the track next to the location where the rescue operations were being carried out. This led to a train passing at the location during rescue, albeit after stopping and local agreements by the staff present, but subjecting them to an unnecessary risk and contrary to procedures.

Furthermore, staff at the location did not realize that traffic should not be running and local arrangements were made for the train to proceed past the site, presumably under the pressure of the situation.

The facts show that the RU doesn't have sufficient control on the effectiveness of training for emergency procedures. In particular, there is no evidence that the generality of staff required to intervene in emergency is submitted to practical trainings or exercises to gain proficiency in using emergency procedures, including when under stress.

In what regards communications, evidence shows that communication protocols between their operational staff and between them and the IM control centres aren't effective in guaranteeing (i) the quality of the information transmitted by the emitting agent, (ii) that the issuing agent gets assurance that the receiving agent fully understood the content of the information, and (iii) that the issuing agent gets confirmation that the required actions were implemented.

7. RECOMMENDATIONS

Following the investigation, seven new safety recommendations are issued, all addressed to Instituto da Mobilidade e dos Transportes, IP (**IMT**), as National Safety Authority:

Rolling stock door opening command system

Context: In several classes of the RU's rolling stock, safety against automatic doors opening at unsafe locations depends exclusively on a deliberate action by the driver; there is no risk assessment for this system and the risk of human error is not mitigated.

 # 2016/01: IMT is recommended to ensure that, within a timeframe accepted by it, **CP** assesses the risks to passengers resulting from the opening of automatic doors at unsafe locations, and implements the measures considered adequate to mitigate, as far as reasonable, the identified risks.

Rolling stock door opening command system

Context: A similar accident may happen at any moment.

 # 2016/02: IMT is recommended to ensure that, as soon as possible and while the measures resulting from the risk assessment mentioned in safety recommendation 2016/01 are not applied, **CP** implements an operating procedure on rolling stock with automatic doors, where necessary, so that the enabling of normal door command to the passengers control is only effective after safety conditions to do so are confirmed.

Rolling stock door opening command system

Context: Possible existence on other RUs operating in Portugal of other rolling stock with a door command system similar to the stock involved in the accident.

 # 2016/03: IMT is recommended to evaluate, as soon as possible, whether safety recommendations 2016/01 and 2016/02 are relevant to other RUs operating on the national railway network, and to promote the measures considered adequate.

Human factors

Context: Evidence shows that the RU doesn't have a system implemented to effectively monitor the drivers' human factors that may negatively influence their performance or behaviour.

 # 2016/04: IMT is recommended to ensure that, within a timeframe accepted by it, **CP** establishes procedures with quantified objectives in order to effectively monitor the human factors potentially capable of affecting negatively the performance of the drivers, based on international best practice in the transportation industry.

Operating procedures

Context: Operating procedures and other documents applicable to emergency situations are numerous and may cause confusion or difficulties of interpretation by the users, particularly on site and under stress.

 # 2016/05: IMT is recommended to ensure that, as soon as possible, the operating procedures' framework applicable to emergencies is evaluated and, if necessary, reviewed, in order as to minimize the risk of error by the intended users regarding actions to be taken.

Communication clarity

Context: Communication protocols used by the RU do not assure that information is transmitted accurately in emergency situations, that the issuing agent gets assurance that the receiving agent fully understood the content of the information, and receives confirmation that the required actions were implemented.

 # 2016/06: IMT is recommended to ensure that, within a timeframe accepted by it, **CP** establishes communications protocols, for use between their operational staff and between them and the IM control centres, adequate to minimize the risk of information not being transmitted accurately in emergency situations, so that the issuing agent gets assurance that the receiving agent fully understood the content of the information and receives confirmation that the required actions were implemented.

Training

Context: Evidence shows that there is no guarantee that the generality of staff required to intervene in emergency is submitted to practical trainings or exercises to gain proficiency in using emergency procedures, including when under stress.

 # 2016/07: IMT is recommended to ensure that, within a timeframe accepted by it, **CP** establishes a training program adequate for staff expected to intervene in emergencies, to develop competencies, proficiency and confidence in applying, under stress, the required procedures.

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