VÉDELEM TUDOMÁNY
KATASZTRÓFAVÉDELMI ONLINE TUDOMÁNYOS FOLYÓIRAT

**Roland Veszprémi, Péter Pántya**

# FIRE INTERVENTIONS AND ITS DIFFICULTIES IN RAILWAY CIRCUMSTANCES

**Abstract**

This paper will examine firefighter responses, their tools and circumstances in cases of railway accidents in Hungary, not including all track-based vehicles. For example, trams, underground and HÉV (commuter train lines) are excluded in the work. The purpose of the work is to gather available information about this topic and organise them by the basic steps of an intervention and to improve the general knowledge. Collected special information with the eye of the first responders, even to call attention to the possible special risks and requirements, on the basis of a previous work. This paper highlights the various number of affecting factors through these tasks, which determinate success of a rescue in case of a train accident. In addition to available studies and literature we made efforts to contact leaders and experts of both fire and rescue services and railway transportation. Through the interviews we were able to gather information from production, maintenance, prevention and responses as well. As a result of this research, we collected a comprehensive knowledge from the viewpoint of a first responder. Further researches could start in the future, for example the review of the protocol for electric separation and opportunities to improve existing systems, essential equipment and tools for the rescue in train accidents.

**Keywords**: train, accident, fire, first responders, technical rescue

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# A TŰZOLTÓSÁGI BEAVATKOZÁSOK ÉS AZOK NEHÉZSÉGEI VASÚTI KÖRNYEZETBEN

**Absztrakt**

Ebben a cikkben a tűzoltók beavatkozásai, azok eszközei és körülményei kerülnek megvizsgálásra vasúti baleseteknél Magyarországon, nem számítva az összes vágányjárművet. A villamosok, a földalatti és a HÉV nem szerepelnek a munkában. A kutatómunka célja a témáról rendelkezésre álló információk összegyűjtése, a beavatkozás alapvető lépései szerinti rendezése és az általános ismeretek bővítése. Sor került információk gyűjtésére az elsődleges beavatkozók szemével - figyelemmel egy korábbi munkára – és cél volt, hogy felhívja a figyelmet a speciális kockázatokra és követelményekre. A cikk a területen keletkező feladatok révén kiemeli a különböző tényezőket, amelyek meghatározzák a mentés sikerét vasúti baleset esetén. A rendelkezésre álló tanulmányok és szakirodalom mellett a szerzők erőfeszítéseket tettek a tűzoltósági, katasztrófavédelmi, valamint a vasúti szállítási vezetők és szakértők konzultációs meghallgatására. Az interjúk során információkat gyűltek a vasúti gyártásról, a karbantartásról, a megelőzés lehetőségeiről és a beavatkozást segítő módokról is. A kutatás eredményeként átfogó ismeretek keletkeztek az elsődleges beavatkozók szemszögéből. A jövőben további kutatások kezdődhetnek például az elektromos leválasztási protokoll felülvizsgálatára, valamint a vasúti balesetek mentésére szolgáló, meglévő rendszerek, alapvető berendezések és eszközök fejlesztésének lehetőségeire.

**Kulcsszavak**: vasút, káreset, tűz, elsődleges beavatkozók, műszaki mentés

## 1. INTRODUCTION

Fire departments respond to numerous cases to save lives and protect material values while countless obstacles make the task difficult and dangerous for both firefighters and those in need of rescue. This publication reviews the obstacles and difficulties of responding to railway accidents, especially the problematics of electric disconnection, its hazards, the rescue and its technical challenges and the medical attendance in case of numerous injured people.

Major railway accidents require larger human and technical resources. The large number of injured people and the numerous simultaneous task require organized cooperation from the different organisations. A previous research had been done by the authors and this article is to highlight and actualize its main sections [1] [2] [3].

## 2. METHODS

During our research the available literature, the relevant regulations, the experience and opinion of the professionals in Hungary of both spheres, the Fire Department and Railway Company had been reviewed. From the Railway Company Fire expert, Plant engineer, Accident prevention and High Wire professional units were consulted. Interviews with the general firefighting and Disaster Management Directorate spheres, including an incident commander of a past railway accident, members of operations, fire subordinate stuff were also conducted.

## 3. RESULTS

### 3.1. Characteristics of a railway scene

Railway scenes can be sorted into peripherial railway line scenes, railway stations and railway crossings. At different scenes different circumstances can affect safety and rescue. For us a safe railway scene means that nor traffic, nor electricity from the high wire (25 kV) means any threat for the interveners or the injured. The staff and the equipment for the electric disconnection and grounding are placed at substations called MÁV CJSC. High Wire Service. The distance between the incident and the substation is of high importance if electric disconnection is necessary. The location of a substation depends on the length of the wire system. For example in Jász-Nagykun-Szolnok County, Szolnok Station is considered a large station because of its marshalling yard and has significantly longer high wire system than other stations. Due to the longer high wire system the distance between the Substations are shorter than the usual. So if an accident happens in the territory of the Professional Fire Department of Szolnok on the Budapest line, then Cegléd and Szajol is the two closest Substations. Between them the distance

is 50 kilometres, so they both cover 25-25 kilometres. Even with such short distance, MÁV CJSC High Wire Service usually needs an hour to arrive. Their standby, departure and transportation is different from those of the Fire Department.

The accessibility and the requirements of the electric disconnection and grounding are the most favourable at railway stations. Most stations are easily approachable and human and technical requirements of electric shut down are available as well. The second most favourable scenes are railway crossings where accessibility from public roads is relatively simple within 200 meters. However an electric shut down can be delayed because of the distance from the substation. The third most favourable one is the peripheral railway line where surfaced roads are usually not available and service roads are usually closed or unsuitable for vehicles. The delay of electric shut down depends on the distance from the substation. [4] [5]

### 3.2. Emergency Call

The precise location of a scene is inevitable information for accessibility and for every successful intervention. The responders are usually face the same problem with that. The railway segment numbers and designations are different from an everyday location address. For example “AS 426 railway crossing” is “Baross street railway crossing” for us. Additionally, railway lines are sometimes separated from public roads and service roads aren’t always available. It isn’t expectable from the staff of a train to know every street and crossing through the whole country so most of the calls contain the railway segment number or the railway designations. This is the first information that we have to use to locate the accident and plan the route to the scene. In locating the accident and planning possible roads for approach, available Information Technology, the experience and skills of the Disaster Management’s Operation Control staff have an important role.

64/2017 MÁV regulation prescribes the particular way of reporting an accident. The precise location of the Station, the number of the railway segment or the number of the switch. The software called DÖMI is what Disaster Management uses to support operations. It has different layers for maps as well. Railway segment numbers can be added to the map, however, a railway segment number is not an address that a GPS navigation system could use. The fire brigades need to be provided with GPS coordinates and additional information for orientation and approach. [6]

ÖTRA, the mobile application originally designed to direct volunteer fire brigades, should also be mentioned, and can be used by professionals as well. The application processes information from emails generated by the Disaster Management's Operation Control and continuously monitors emails, displays the information on the fireman's mobile in text and in Google Maps as well. So the marked railway segment number, public road kilometre segment number even unnamed roads become a trackable address in GPS coordinates so the application can navigate us to the location. Correction of a location can be done on first arrival so other units will be navigated to the correct GPS location. Similar development of professional fire brigade's "MiniPajzs" system is suggested. The preparation of intervention

The preparation of an intervention means to provide the required tools and conditions for the crew. The first step is to create a safe environment for the rescue work, therefore the Railway Control Centre and the relevant organisations (Ambulance, Railway Accident Prevention Unit, High Wire Service Unit) have to be informed. Closing the area or setting speed limit for the connecting lines can be necessary as well. In case of a large number of injured people Ambulance Service should be consulted about the triage and the rescue order.

For electric shut down the professional service staff must be used. Electric shut down starts with the disconnection of the railway line section. It can be done at the Control Centre with remote control, at substations or at the scene, therefore the disconnection of the entire line can be initiated by a phone call. However it is only the first step of an electric shut down. There is a switch for preventing automatic reconnection but electric inspection, grounding and separation from other devices can only be done at the scene by placing the grounding rods.

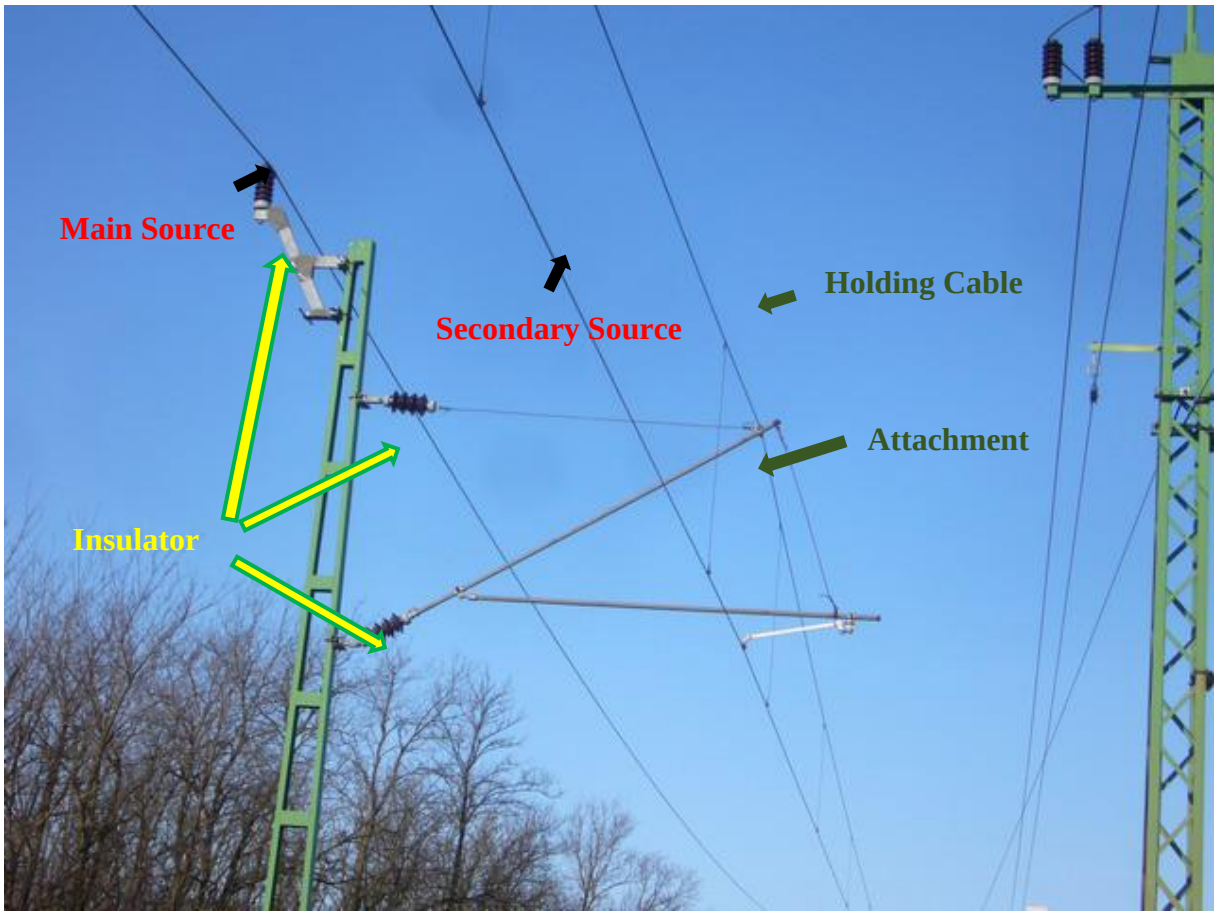


Figure 1 - Line high wire system (Roland Veszprémi)

The main source and the secondary source cables transfer high voltages (25 kV). On a two or more lines railway the secondary source cable substitutes for the main cable. By disconnecting the main source cable the secondary cable is still under electric current. In case of wire tear other metal parts can have voltages as well. In that case the approach of the train is forbidden even for rescue.

This is why electric shut down is only considered complete when the grounding rods are placed on both sides of the scene and the authorized person issued the certificate form. The grounding rods are stored on stations and at the High Wire System Service. The delay of an electric shut down depends on the location of the scene so this is why distance is an essential thing in this matter. If the scene is at a disadvantageous location than the rescue can be delayed as well.

However the V43 and V63 electric locomotives had their own grounding rods on board and a staff were authorized to use them. The conductor had to be able to make a full electric shut down on the train because they had to perform maintenance works on the train's electric

connection. From the viewpoint of a firefighter it could be very useful, if the conductor – who obviously is the first observer of the accident - could create safe environment for the rescue. The conductor could notify the Control Centre to disconnect the electricity and to stop traffic then place the grounding rods and stabilize the train so that the circumstances could be suitable for an intervention without delays. Recently the electric locomotives have different methods to shut down. As for the rescue we can sort them into two categories. Some of them must be shorted by grounding rods while others have their own mechanism for grounding. The engine space of older types provided enough space for the grounding rods (For example: V43 and V63, however those rods had been dismantled). For newer types, for example Flirt electric locomotives, the manufacturer built a mechanism into the train to disconnect and ground the vehicle so maintenance staff can work.

However, this method is to shut down only the train and not the high wire system and it is only usable if the train is on the tracks and the system isn't damaged. These locomotives don't provide enough space for the older grounding rods so a shorter tool has been made. For example the Pfisterer manufacturer has telescopic grounding rods made of several parts that can be assembled when necessary. The storage bag is only 1m * 0,3 m.


Picture 1 - Different elements of grounding. Source: Pfisterer, www.catalogue.pfisterer.com/

### 3.3. Intervention

For an effective intervention we should be aware of the routines, phrases and the infrastructure of the Ambulance. In case of mass injuries the first responder has to face a situation with more tasks than can be performed in time. Triage and a well organised co-operation can be a solution.

### 3.4. Infrastructure of an intervention

The sorting of tasks and the segmentation of the area can be crucial for effective co-operation. With a well organised scene and the knowledge of the other organisations routines we can improve each other's efficiency instead of decreasing it.

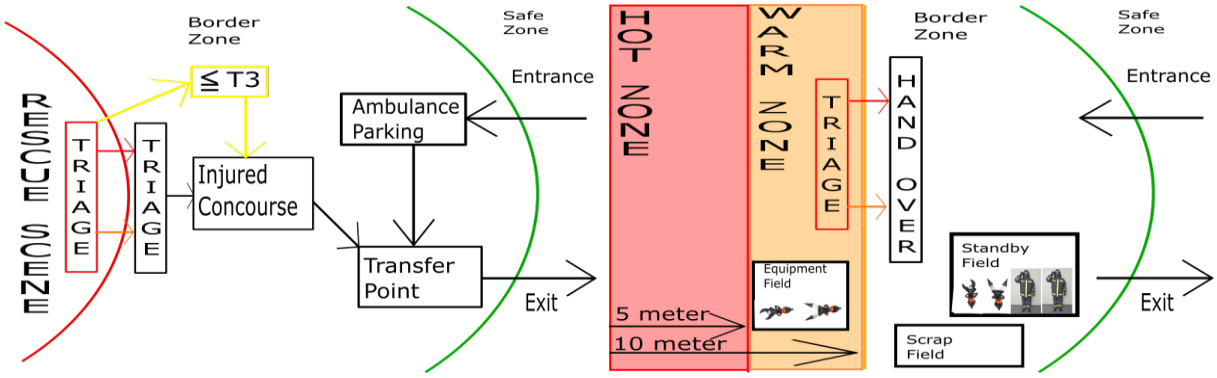


Figure 2 - The infrastructure of the Ambulance and the Fire Department (Roland Veszprémi)

On the one hand ambulance will enter the scene and start their work with triage and medical attendance only if the environment is safe enough for their work and personal protective equipment. On the other hand fast and proper technical rescue is the key to ensure required medical attendance and to save lives. The work of the Fire brigade and the Ambulance are inseparably linked. During extraction, ambulance and rescue operations in the "Hot zone/Rescue scene" can't be separated in time or place. Respiration, general circulation, thoracic spine, medication must be ensured during the cutting and spreading operations. Ambulance staff have lesser personal protective equipment than fire brigades so we must create the environment as safe as possible. [7] [8]

### 3.5. Experiences of the past

Former equipment (Lukas GO3T hydraulic combined rescue tool) weren't suitable for the challenges of railway accidents of the past. The lack of other equipment was experienced as well. The thickness of different materials, the need of continuous cutting, the height of the working zone made rescue work more difficult, however these obstacles could be easier to take with special equipment.

- Scaffold for rescue work
- Special, heavy duty cutting equipment
- Hydraulic rams

- Saber saw

During the rescue from a railway carriage we face more different hazards than usually. In a coach there are several cables, pipes for electricity, air of oil under the insulation. The air pressure is about 10 bar. The insulation is mostly glass wool so respiration and eyes must be protected with dust protection masks and glasses. Until the disconnection of the locomotives' own battery pack heating and controls of the coach is under charge. The voltage is low but the amperage is high, therefore electricity and air pressure are both capable of causing damage in equipment or injury to the crew. Before stripping the coach's structure the battery pack should also be disconnected and the air system deflated. [9] [10]

## 4. DISCUSSION

The special challenges and circumstances [12] require special solutions [13] so that the intervention can be more fluent and efficient. The problems discovered can be solved with the purchased or available equipment and organising principles.

We believe that it is necessary to review MÁV electric shut down protocol and to place the grounding equipment on the railway vehicles. Especially that the former electric locomotives had the equipment and their driver were authorized to do the grounding. This ability of MÁV company could make interventions far more effective in the future.

Precise localisation of the incident and navigation to the scene are essential elements of an effective intervention [14] [15]. The railway segment number is visible every one hundred meters and the railway staff usually navigates by them so this information is most likely available for the fire brigade as well. By the GPS coordinates – recovered by segment numbers - ÖTRA – or with developments in "MiniPajzs" - the navigation of fire brigades could be well supported.

A vehicle with the proper off-road ability can be sent to the scene if the information from the emergency call – or with the support of the informatics system – justify the need. At an incident with higher volume, two or three hundred meters can be significant during the carrying of

equipment or injured people if our way is impassable for the fire engines. The circumstances can vary by slippery, muddy environment or falling hazards.

More difficult, complicated situations [16] can occur in railway accidents than usual at public road accidents. The thickness of materials can make cutting and spreading work difficult or impossible without the right special equipment for the task. The wider availability of these equipment are important for the effective rescue work. We believe that related researches in the topic are necessary and will be actual for a longer period of time [11]. The experiences described in the article will later be used in education and various practices [17] [18].

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