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Realisation of fire and intrusion protection at the "Diabolo" train tunnel complex at Brussels Int'l Airport

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ABSTRACT

Between October 2007 and June 2012, the Belgian Railways Group and its partners built a new railway tunnel under the main runway of Brussels Airport, to unlock the – also enlarged – station from the unidirectional connection that was available at that time. To facilitate evacuation, intervention and rescue in this newly built 4 km long infrastructure of the so-called Diabolo project, we designed an automated fire scenario system which is part of the tunnel's and station's safety concept based on EU Directive 2001/16/EC, NFPA 130 and UNECE TRANS/AC.9/9. Furthermore we implemented access control and intrusion detection as part of the complex' security concept. In this paper we present our design and our experiences of setting up the system. We also present our real "burning" train test, which took place during the commissioning phase of the project and was a unique opportunity to test the system's response to "a train on fire" entering the tunnel complex.

The Diabolo railway line

Since June 2012, railway travellers can make use of the Diabolo railway line to travel more swiftly to and from Brussels Airport. Part of this railway line is a recently-built underground railway link that unlocks the airport to the north, ensuring a better connection to the city of Antwerp and the Netherlands (see Fig. 1).

The Diabolo project was the second step in Infrabel's strategy to provide an improved access to Brussels Airport by rail, after the construction of the "Nossegem curve" had already improved travel time from the east (Liège, Germany) in 2005. The recent construction works unlock the potential of Brussels Airport to attract travellers from neighbouring countries – and get them to the airport by rail.

The Diabolo project was a joint effort of several entities of the Belgian Railways Group:

- rail infrastructure manager *Infrabel* (acting as founder of the project), its engineering subsidiary *Tuc Rail*, its ICT department and some smaller specialist entities,
- train and station operator *NMBS*, its station development subsidiary *Eurostation*, its *Corporate Security Service* (*CSS*) and some smaller specialist entities,

in cooperation with private financing partner *Northern Diabolo NV* and several stakeholders such as the fire departments of the towns of Zaventem and Vilvoorde and the Brussels Airport Company.

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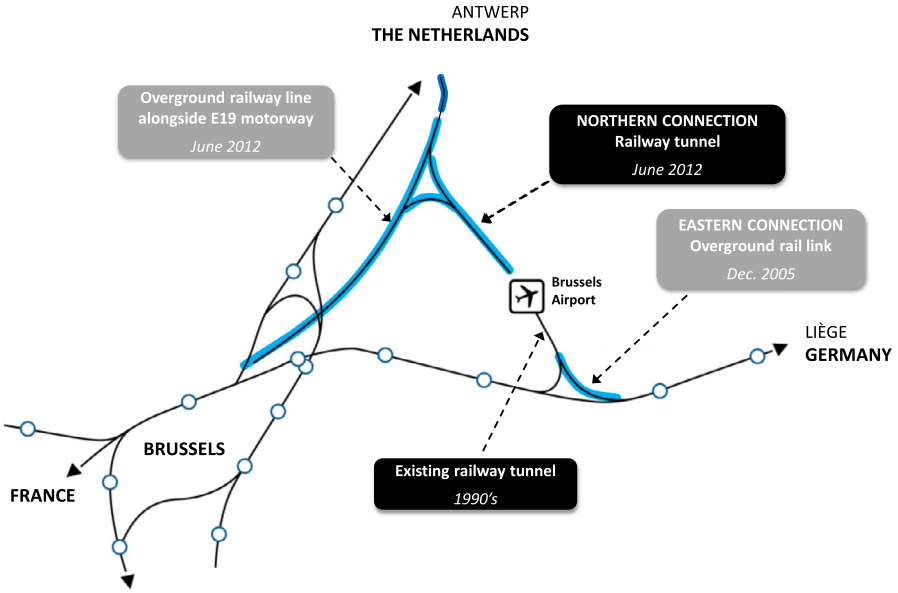

Fig. 1. The Diabolo tunnel realizes a direct rail connection from Brussels Airport to the north.

Required level of safety and security

The Safety & Security Steering Group of the project team (consisting of the owner, final users, architects, engineers and specialists) elaborated the project's safety requirements [1] based on the fire prevention report written by the fire brigades of Zaventem and Vilvoorde [2]. The entire complex – consisting of the new train tunnel as well as the already existing train tunnel and the enclosed underground railway station at Brussels Airport – is situated in three municipalities and is covered by those 2 fire brigades for fire intervention. *The fire brigades mainly based their joint fire prevention report on international tunnel safety recommendations*, as there are no specific national fire safety standards or bylaws for train tunnels in Belgium. In particular, the fire brigades referred to *NFPA 130* [3], *UIC-Codex 779-9* [4], *UNECE TRANS/AC.9/9* [5] *and TSI dir. 2001/16/EC* [6]. These documents give both input for the strategic setup of the safeguarding process as well as prescriptive rules on structure and technical installations to be followed. A good combination of all these measures has fully been studied and documented within the Safety & Security Steering Group. Also these 4 documents give a framework to introduce so-called *"fire scenarios" (this is the automatic and logical response of all safety equipment to a first or confirmed fire detection)* but this automatic response is *not* as such defined in their texts or only in a part of it (e.g. functionality of emergency ventilation). Of course the need for adequate detection and a wide range of safety equipment has been written down, but not the automatic link between those two domains of input and output. Later on in this paper we show a practical way to setup these automatic links.

In the fire brigade report *the existing enclosed railway station and the existing train tunnel were considered as an integral part of the new enlarged tunnel infrastructure with respect to the application of the safety regulation.* Hence, the existing terminus station and tunnel (with a total combined length of 1.8 km) got an important technical upgrade to end up with the same safety and security level as the new tunnel (with a total combined length of 4.2 km together with the enlarged station and the existing tunnel).

Fig. 2 shows how the project team implemented the international tunnel safety recommendations. One of the basic premises with respect to this elaboration was the fact that this tunnel is only used by electric passenger trains, and the train speed is always controlled to a maximum of 90 km/h. As depicted in the figure, the use of ICT techniques fits into a larger context of tunnel standards and regulations that typically classify safety measures for tunnels into different areas (infrastructure, rolling stock, operations) and different possible phases of an accident (prevention of accidents, mitigation of consequences, facilitation of escape, facilitation of rescue). The measures fulfilled by the Diabolo ICT techniques mainly span the infrastructure area across the different possible phases of an accident.

Specific security requirements consist of the prevention and detection of unauthorized access to all non-public areas of the station and tunnel complex, and the dissuasion and obstruction of undesired human behaviour (aggression, terrorism).

Technical installations overview

The Diabolo ICT techniques mainly include an *integrated system* for the automation of fire scenarios [7], two *control rooms* that allow efficient remote management of the tunnel complex, as well as a number of *communication systems* used by the