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company paper

EVERY SECOND COUNTS - THE SAFETY OF PEOPLE AND GOODS IN TUNNELS.

BEST PRACTICE: INNOVATIVE FIRE AND SECURITY SOLUTION USING THE EXAMPLE OF "ZENTRUM AM BERG".

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ABSTRACT

Tunnels are among the most demanding environments for fire safety technology and require careful planning and rigorous testing before commissioning. From road tunnels to subway and railroad tunnels, these structures serve as an integral part of modern infrastructure and need to remain operational around the clock. The operational requirements, difficult-to-access installations and the safety of both the people and goods that pass through tunnels, pushes the expectations of fire safety equipment, software and knowhow to an even higher level.

To obtain approval for using the automated fire detection, the company must prove that the maximum fire detection time according to RVS (Guidelines and Regulations for Planning, Construction and Maintenance of Roads in Austria) is not exceeded.

For tunnel projects this test was essential to be able to deliver automated fire detection in Austrian tunnels.

1. INTRODUCTION

In 2010, a report by the Austrian Court of Audit showed the public that one-fifth of the investments in the road and rail tunnels examined in the report went toward safety. In the case of the road tunnels investigated, as much as a quarter of the costs are for safety. [1] This report gives a very deep insight on the safety of tunnels in Austria.

In the Brixlegg rail tunnel, the probability of a fatal accident is one in 10 billion and in the Sonnstein tunnel, one in 100 billion. A safety concept commissioned by ÖBB in 1995 is also mentioned:

"Marginal costs for the prevention of a "perceived fatality" weighted higher on the basis of the aversion factor in the amount of approx. 7.27 mill. EUR (100 mill. ATS), up to which cost-effectiveness ratio measures are sensibly to be realized. Because of the consideration of the aversion factor, ÖBB actually invests about 36 mill. EUR to prevent a (real) fatality;" [1]

In contrast to rail tunnels, an average of six fatalities occurred in Austrian freeway and expressway tunnels in the period 1999-2019 and the average economic accident costs amounted to 24.0 million euros per year. According to ASFINAG's incident database, there were 130 fire incidents in tunnels over 500m and its portal areas in the period 2006-2019. In these fire incidents, four people lost their lives, the last time in May 2016. [2]

All this and much more illustrates the investment needed to make safety a reality in tunnels.

2. DATA

Let’s have look at the basics of fire detection for tunnels in Austria.

2.1. Fire detection in railroad tunnel

According to the regulation concerning the technical specifications for interoperability relating to "safety in railway tunnels" of the rail system of the European Union, minimum safety requirements must be met.

The EU stipulates that all railroad tunnels longer than 1km must be equipped with fire detection in the technical rooms and the alarms are transmitted to the infrastructure managers. Stations that are in tunnels shall be in conformity with the national rules on fire safety. When they are used as safe areas and/or fire fighting points, they shall comply only with the relevant specifications must be met. [3]

These EU directives have been implemented in the Railway Act.

2.2. Fire detection in road tunnel

Tunnels in the Trans-European Road Network must meet minimum safety requirements. The EU stipulates that a system for automatic detection of traffic incidents and/or fires shall be installed in all road tunnels more than 500m in length with a control center. For road tunnels more than 500m in length without a control center, automatic fire detection systems shall be installed. [4]

In Austria, the EU specifications for minimum safety requirements were implemented in the Road Tunnel Safety Act (STSG). Here, only road tunnels with a ventilation system must be equipped with an automatic fire alarm system in case of fire. [5] For road tunnels in Austria, individual guidelines and regulations are declared binding by service instruction or decree according to §7 Para. 2 of the Federal Roads Act. [1] This brings into play the RVS (Guidelines and Regulations for Road Construction), which reflects the current state in Austria and the bindingly declared RVS 09.02.22 for tunnel equipment, which specifies everything that fire detection for road tunnels must be able to do and fulfill. The automatic fire detection system for the driving area must also ensure that it can trigger within a short time.

Table 1: maximum fire detection time, according to RVS for the fire detector in the road tunnel [6]

LONGITUDINAL AIR VELOCITY [m/s]	**FIRE DETECTION [s]**		**FIRE LOAD**
	PRE-ALARM	ALARM	
< 3	60	90	2 x 1m² pool fire with 10l ethanol each
≥ 3	120	150	2 x 1m² Diesel pool fire with 10l diesel each - and 5 liter gasoline each

Furthermore, for the road tunnels of highways and expressways there are still the planning manuals which then require, for example, that a pre-alarm is to be detected and reported, but which is not evaluated, or does not control anything.

2.3. Test fire Saalbach Hinterglemm

For our fire detection system to be allowed to be used in Austrian road tunnels, it had to be tested and approved by an accredited inspection body. This was achieved in 2015 with the following test results:

Table 2: Test fire Saalbach Hinterglemm

Tunnel test fire - Tunnel Hinterglemm - 23.11.2015detection times / Linear Heat					
tripping timesresults	Airlongitudinal velocity m/s	DTS west		DTS east	
		pre alarm	alarm	pre alarm	alarm
ethanol fire					
14:29:00	< 3	14:29:52	14:30:02	14:29:56	14:29:56
		00:00:52	00:01:02	00:00:56	00:00:56
14:51:00	< 3	14:51:52	14:51:52	14:51:46	14:51:56
		00:00:52	00:00:52	00:00:46	00:00:56
petroleum diesel fire					
15:10:57	≥ 3	15:11:52	15:11:52	15:11:46	15:11:56
		00:00:55	00:00:55	00:00:49	00:00:59
15:33:52	≥ 3	15:34:52	15:35:02	15:34:56	15:34:56
		00:01:00	00:01:10	00:01:04	00:01:04

3. SUMMARY AND CONCLUSION

All this and more illustrates the investments we make to prove our technology in order to provide institutions such as the Tunnel Research Center of the University of Leoben "Zentrum am Berg" with the best possible solution.

WHICH SOLUTION SUITS BEST IN A TUNNEL; WHICH TECHNOLOGIES ARE USED?

Honeywell offerings installed at ZaB include fire detection solutions, public address and voice alarm system (PA/VA), and an alarm and video management system in the road and rail tunnels.

The main technology in Fire Safety is the latest generation of Honeywell’s DTS (Distributed Temperature Sensing) linear heat detectors. In the ZAB, there are two DTS detectors installed, each in redundant loop configuration to support reliable operations. They are connected in single-mode configuration by a fiberoptic essernet® network which is also processing signals from point detectors and new VES aspirating smoke detectors. By combining these fire detection systems, both fire and smoke can be detected in their very early stages, preventing false alarms even under challenging conditions.

The PA/VA system inside Zentrum am Berg's tunnels is realized with the Digital Output Module (DOM) from the VARIODYN D1 range which is EN54 certified and features multicasting and integrated power

amplifiers. For display and operation, the Ethernet Touchscreen Call Station (ETCS) offers a 7" touchscreen with a user-friendly interface.

The PC-based hazard management system WINMAG is a key element of the alarm and video management system. WINMAG's graphical user interface allows users to quickly localize hazards even in complex system environments with minimal training requirements, saving valuable time in incident response.

Thanks to its modular and scalable design, WINMAG allows full integration of Honeywell's server-based video management system MaxPro. By providing real-time alarms and detection of abnormal behavior without human supervision, MaxPro further contributes to the system's efficiency, both in terms of cost saving and safety requirements.

Every second is valuable in case of an incident in a tunnel. Modern Fire Safety and Security solutions and a fast evacuation is essential in a tunnel for saving lives and property. [7]

4. REFERENCES

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[6] RVS 9.02.22 Tunnel Equipment

[7] Case Study "Zentrum am Berg" by Honeywell Life Safety Austria GmbH