SAFETY MANAGEMENT FOR AUSTRIAN RAILWAY TUNNELS

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ABSTRACT

The Austrian Federal Railways (ÖBB) are currently operating 293 tunnels, and the number of tunnels is expected to rise considerably, as the number of construction projects is anticipated to increase in years to come.

Including the future tunnel user (operator) into the design process, setting up uniform emergency response regulations and organizing the co-operation between the railway company and rescue services constitute key components in the safety management for railway tunnels.
With respect to regulations, a special focus is put on initial operational emergency response measures, self-rescue procedures and emergency management regulations.

Keywords: safety, railway tunnel

1. INTRODUCTION

In Austria, the Alps, which form the largest mountain range in Europe, have always played a dominant role. As early as 1884, the Arlberg tunnel, the first major railway tunnel, was opened to the public. Subsequently, additional large-scale tunnel projects followed on the Austrian rail network, including the Tauern, the Karawanken and the Bosruck tunnel.

Whilst the number of tunnels forming part of the Austrian rail network has remained more or less stable for a long time, it is now – mainly due to line improvement projects and new high-speed line projects – increasing substantially, with growth rates comparable to those of the construction boom at the end of the 19th century. In fact, the percentage of tunnels in the ÖBB's tunnel network is expected to triple up to the year 2025 (see Figure 1).

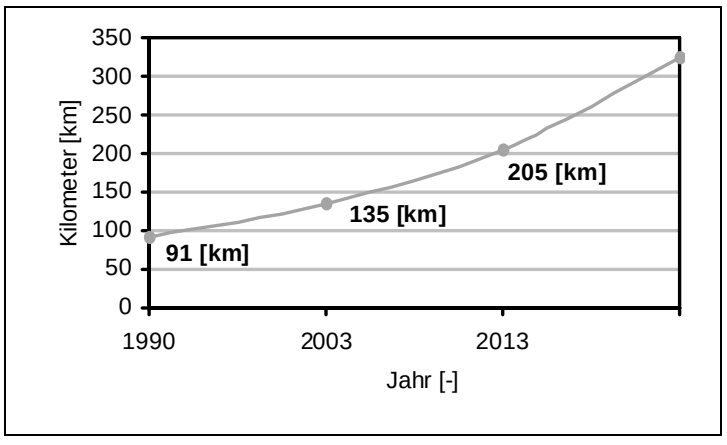


Figure 1: Development of the total length of all railway tunnels in the ÖBB network

In total the Austrian Federal Railways (ÖBB) are presently operating 293 tunnels, 29 of which are longer than 1,000 m. The longest tunnel so far, the almost 13-km-long Inntaltunnel, will not remain the only tunnel of such length. The Wienerwaldtunnel, the Lainzertunnel, the Unterinntaltunnel will be completed in 2012, the Koralmtunnel (approx. 33 km in length) is currently under construction and projects like the Brenner Basistunnel (approx. 55 km) and the Semmering Basistunnel are currently under design.

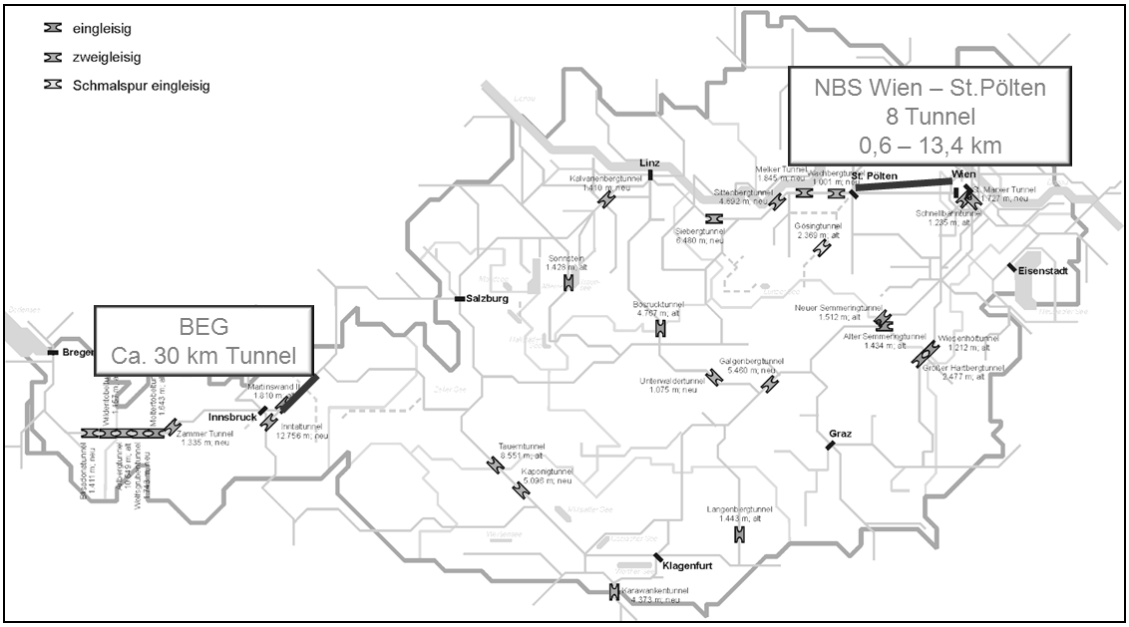


Figure 2: Existing tunnels with a length exceeding 1 km and new tunnels to be taken into operation

In order to maintain a very high safety level for all tunnels in Austria, standardised safety management documents and procedures are imperative, in both the design phase and the operating phase.

2. SAFETY PLANNING DURING THE DESIGN, COMMISSIONING AND OPERATING PHASE

The planning of the required safety measures is continuously developed in the individual phases of a tunnel project and is gradually elaborated in more detail as the design of the project progresses.

When developing safety concepts for railway tunnels in Austria, the following parties tend to be involved:

- Tunnel owner (represented by the project management)
- Engineering departments of tunnel owner
- Designers of safety concepts as well as other expert designers
- Reviewers and experts involved in the permitting procedure
- Future technical operators of railway tunnel systems
- Future user of the railway infrastructure, including railway tunnel systems. [1]

[1] This organisation is in Austria not identical with the operator of railway tunnel systems.

The concepts are continuously co-ordinated with the fire brigades and other emergency response organisations – if required.

The owner of the tunnel is responsible for designing and constructing a tunnel, the safety equipment of which will have to meet state-of-the-art standards. The operator is responsible for providing a reliable tunnel system (inspection, maintenance and repair). And the user is responsible for

- implementing the tunnel safety concepts
- preparing the necessary codes dealing with organisational and operational issues
- organising the deployment of skilled staff members
- coordinating the cooperation with rescue services
- considering experiences made during tunnel operation
- considering insights gained during incident management
- reviewing and updating existing concepts

For decisions to be made on structural safety measures and safety equipment requirements in tunnels, reference is made to the respective guidelines and regulations. Reference documents used for tunnel-specific issues include the following guidelines and regulations:

- Technical specification of interoperability (TSI) relating to ”safety in railway tunnels“
- Occupational safety and health regulations for railway personnel (EisbAV)
- Guidelines for the design of HIGH-SPEED railway systems
- Guideline ”Construction and Operation of New Railway Tunnels on Main and Branch Lines; Demands Made on Fire Protection and Emergency Management“; issued by the Austrian Fire Fighters Association

By involving the user in the design process, it is possible to incorporate both, experiences made under “normal” operating conditions as well as those made under incident management conditions. This approach also allows the future operator to secure any personnel and material resources required in due time and to make them available for operation start-up and operation.

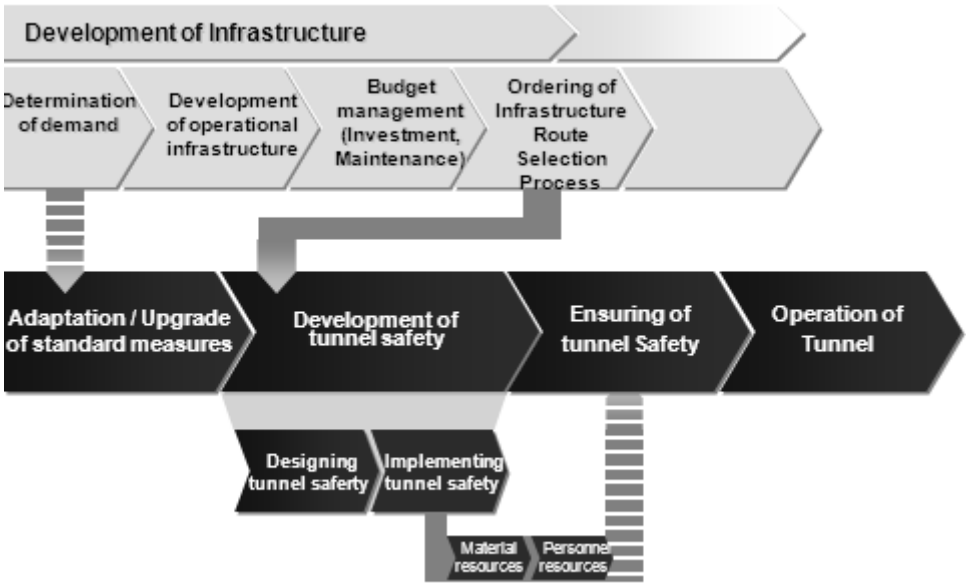


Figure 3: Involvement of tunnel user in development of safety concepts (example)

As is evident from Figure 3, the user is involved in the development of the safety concept at a very early stage of the project.

During the permit application procedure in compliance with railway law, the safety concept is reviewed and approved by the relevant authority.

During the operating phase, possible retrofitting needs in response to the development of new safety standards or the enactment of new laws are identified and implemented by the ÖBB management, considering various aspects.

In the year 2009, owner, operators and user were brought together, setting up the ÖBB-Infrastruktur AG.

3. EMERGENCY RESPONSE AND SAFETY DOCUMENTS

Essential instruments of safety management are the elaboration of emergency response regulations as well as a consistent and comprehensive documentation of the safety equipment available in the individual tunnels. Any further development of regulations is efficiently communicated and implemented by staging training sessions and information workshops for staff members.

3.1. Initial emergency response measures

If a fire is detected on a train running through a tunnel, the prime objective consists in moving all trains – and especially the emergency train – out of the tunnel.

Should there be signs indicating that a train has derailed, the initial response measure – in analogy to a train derailment on an open track section – is to bring the incident train as well as all trains approaching the incident scene to a halt as quickly as possible.

These instructions are laid down in the regulations and are to be implemented by the operating personnel. The regulations apply to all trains serving the ÖBB network.

If a fire occurs, other trains shall be prevented from entering the tunnel. All trains travelling through a tunnel at the same time as the incident train, should leave the tunnel if possible, without endangering any person leaving the incident train in a self-rescue effort.

These procedures are initiated and monitored by the train controller in the train operations centre.

Figure 4: Train controller at train operations centre

3.2. "Self Rescue" Procedure

Every safety concept developed for current tunnel projects is based on the principle that the predominant emergency response will be a self-rescue effort of passengers assisted by train personnel. In the "Self-Rescue" regulation ZSB 24 (amendments to signalling and operating regulations) of the Austrian Federal Railways (ÖBB), this principle is uniformly defined for the entire Austrian network. This regulation contains instructions for the train staff supporting passengers in a self-rescue situation.

Figure 5 presents the key principles of this regulation.

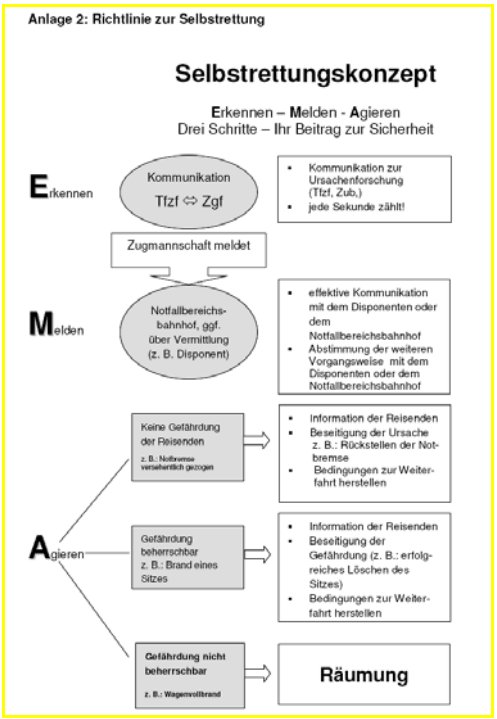


Figure 5: Self-Rescue Procedure

A crucial criterion in this process is the actual decision to conduct a self-rescue effort. This decision is either made by the train crew or by the train driver. The train operations centre, which is responsible for the respective emergency area, should be informed prior to any evacuation operations, to allow them to take the necessary protective measures (e.g. prevention of potentially dangerous train traffic).

3.3. Emergency response management by the ÖBB-Infrastruktur AG

The emergency response manual ZSB 26 provides instructions regarding such issues as areas of responsibility (e.g. incident commander), systematic implementation of measures following the occurrence of an incident (search for causes, continued professional training, technical measures) as well as frequencies and contents of emergency drills. These instructions shall be applicable to the entire railway line network including the tunnels. The manual furthermore contains check lists, layout drawings, and alarm plans, which serve as templates for emergency folders, which are adapted to the conditions prevailing at the respective railway line and tunnel structures.

Notfallbereich | INFRA.netzbetrieb | ÖBB Infrastruktur Betrieb
Ereignis-Checkliste (ECL)

Meldung Nr: | Datum: | Zeit:
Fdl: | Fahrt (Zugnummer):
in (zwischen):
Gleis: | Weiche: | Signal: | km:

Vorfall:

☐ Verletzte ☐ Tote — Gefahrnummer
☐ Brand
☐ RID-Gut (Artikelbriefe, Frachtbrief, Feststellung vor Ort, OK) — UN-Nummer

1. SCHÜTZEN

- Haltstellen von Signalen ☐
- Nothalt über Zugfunk (DISPOLINIE 88) ☐
- Verständigung der angrenzenden Betriebsstelle (Rotte…) ☐
- Oberleitung NOT-AUS bzw. Gefahrenabschaltung Basa 7760 ☐
- Evakuierung bzw. Absperrung bei Feuer / Gefahrgut / Bombendrohung veranlassen (Selbstschutz!). Fahrt nicht im Tunnel anhalten! ☐

2. HELFEN, HILFE ANFORDERN

Hinweis auf gesondert notwendige Zustimmung zum Betreten nicht allgemein benutzbarer Bahnanlagen!

Verständigung Zuständigkeitsbereiche	Von km Bis km	Von km Bis km	Von km Bis km	Von km Bis km	Zeit:
Rettung / Notarzt (0)144					
Feuerwehr (0)122					
Polizei (0)133					

3. BETRIEBLICHE MASSNAHMEN SETZEN

- Gleise sperren / Keine Fahrten ☐
- Freischalten der Oberleitung ☐
- Erdung sicherstellen ☐
- Selbststellbetrieb ausschalten ☐
- Hilfssperren, Zielsperren, Befahrbarkeitssperren bzw. Hinweisschilder setzen ☐

→ *Fahrstraßenprüfung / fmdl Rückmelden / Freiprüfung (AS, DS, BS) ???*
→ *gegebenenfalls Störleitfaden Störcheckliste verwenden!*

4. VERSTÄNDIGEN

	Rufnummer	Zeit
FDL-Notfallkoordinator Anforderung Hilfszug, Mungos (Absperrungen, Evakuierung), EL	7777	
Dispo Zugleiter		
Betriebsmanager		
INFRA service über ZSM bzw. ESDB		
Verständigung Kriseninterventionsteam über Rotes Kreuz		

Figure 6: Incident check list and meeting point of emergency service coordinators

3.4. Tunnel safety documentation

The tunnel safety documentation concisely describes the tunnel structure and the safety equipment. It furthermore specifies operational and organisational measures, which go beyond the general ÖBB regulations. The tunnel safety documentation is available at the respective train operations centre. The corresponding drawings highlight all installations and structures which are of relevance for the safety of the tunnel.

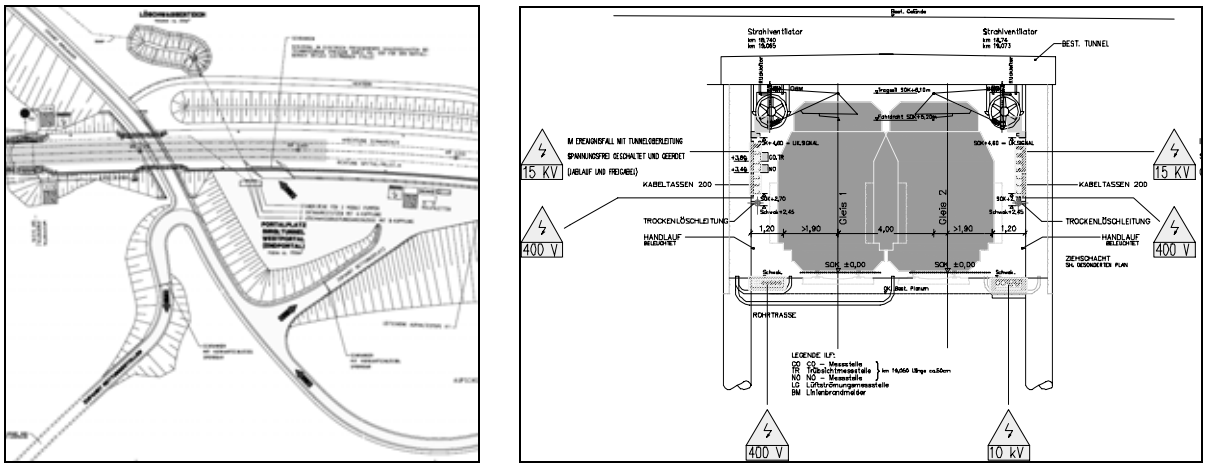
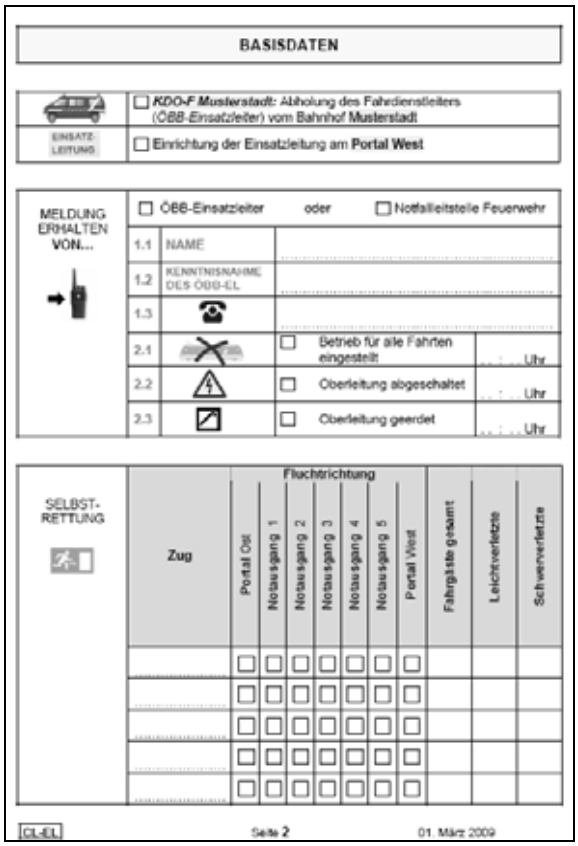


Figure 7: Drawings showing tunnel safety features

4. COORDINATION AND SUPPORTING DOCUMENTS FOR FIRE BRIGADES

In a joint effort of the Austrian Fire Fighters Association and the Austrian Federal Railways, the manual "Fire-fighting Operations in Track Areas" was developed, which combines the safety interests of the Provincial Fire Fighters Associations and the Austrian Federal Railways in one document. This document which describes the fire-fighting services in track areas from a safe operations perspective, allows these services to be regulated all over Austria. This manual not only lists possible dangers encountered during operations at railway infrastructure sites, but also offers a number of valuable tips to protect the fire-fighting teams.

In a new edition of this manual issued in 2009, the topic of "rescue services in tunnels" was added to the existing information. The complexity of tunnel structures and the interaction with technical installations and organisational procedures call for rescue operations to be performed in a highly structured way. Check lists shall support the rescue organisations as well as the ÖBB staff members, by increasing their confidence to take the right actions and ultimately by contributing to improving the safety of the rescue teams.



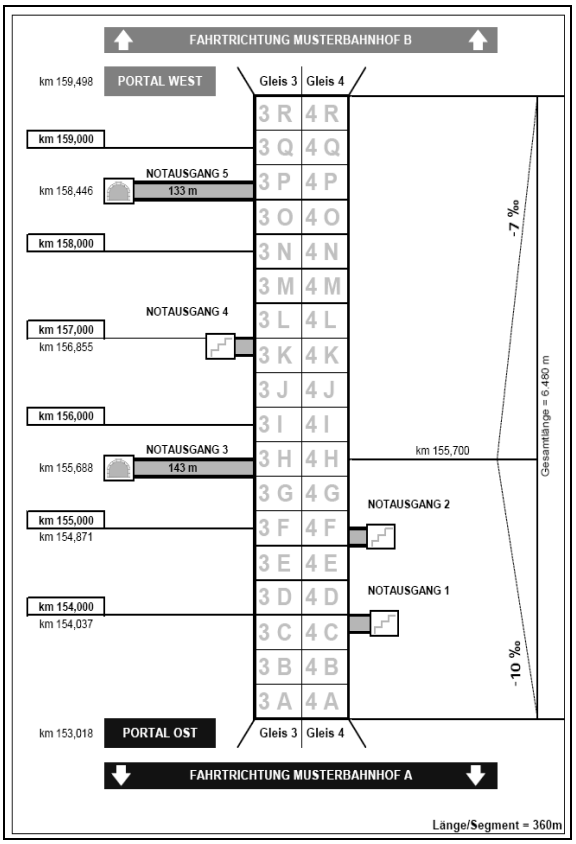


Figure 8: Check list for the fire service coordinator (excerpt)