

VEREINA TUNNEL – SAFETY CONCEPT



Safety and Rescue Concept Vereina tunnel, Rhaetic Railway, Chur, Switzerland

The Vereina tunnel is part a winter safe railway link between Klosters (Davos) and Sgialsins (St.Moritz) in the Engadin. The narrow gauge single-track tunnel has a length of 19'042 m. Amberg Engineering has developed a specially tailored safety and rescue concept. The required safety measures were investigated for feasibility at the level of a preliminary project.

Scope

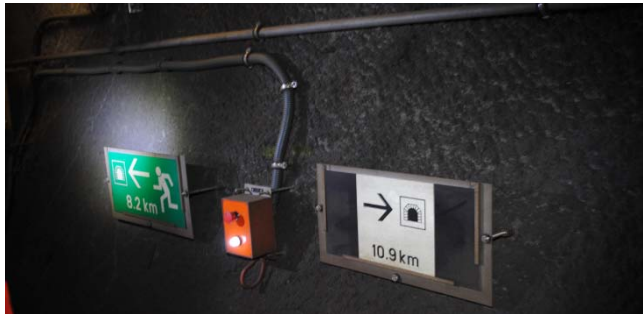
- Definition of an integrated safety project of the Vereina tunnel
- Cost estimate for proposed safety measures

Challenges

- Existing emergency exits only at portals of the tunnel
- Intersection area in the centre of the tunnel.
- Car loading operation ("rolling road")
- Realization of safety measures should not impede the normal operation

Amberg Services

- Closer analysis of safety relevant incidents since start of tunnel operation
- Identification of adjustment requirements and assessment (Prevention, technical measures, self-rescue and intervention)
- Amendment and update of the safety and rescue concept where necessary
- Investigation of the required safety measures, prioritization and cost estimate



- Supporting of self-rescue in tunnel



- Firefighting and rescue train



- Modern fire extinguishing systems

AMBERG FACTS

Contracted value Amberg

- Total 2.5 Mio. CHF

Project phases & duration

- New safety concept 2014 – 2016

Project details

New integrated safety and rescue concept

- Closer analysis of safety relevant incidents after begin of operation
- Evaluation of actual operation concept
- Thorough assessment and verification of the existing safety concept, risk evaluation and assessment
- Proposal of new safety and rescue concept, identification and prioritisation of required measures

Concretization of measures

- Determination of achievable risk reduction
- Pre investigation of cost
- Critical assessment of cost effectiveness.
- Stepwise realization of investments / measures
- Initial project for constructional measures in the intersection area

CLIENT FACTS

Overall cost

- Total Vereina tunnel approx. 670 Mio. CHF
- New safety concept approx. 51 Mio. CHF

Overview project

- Investigation of safety relevant technical questions
- Identification of weak points in the former safety concept (altered operation concept)
- Establishment of the new concept, tailored to the operational concept and object specific risks
- List of priorities of the required safety measures
- Cost estimation of the safety measures
- Step by step realization of the safety measures adapted to the framework of the budget

Contact person

RhB – Rhaetian Railways, Chur, Switzerland

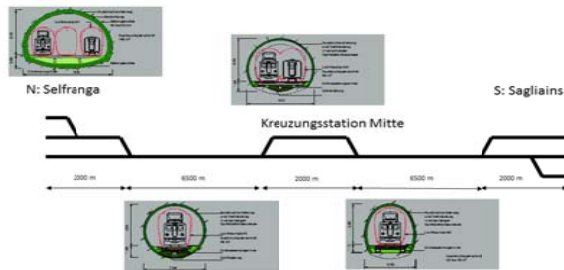
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CHALLENGES



Tunnel profiles for the different sections of the tunnel

Car loading, single track tunnel, intersection area

- Existing railway tunnel, over 19 km long
- Mixed traffic with passenger transport, car carrying and freight transport
- Existing exits only at portals
- Intersection areas in tunnel centre and close to portals
- Steady increase of traffic, existing level of safety must be maintained in minimum

ENGINEERING APPROACH

Häufigkeit	A häufig					
	B wahrscheinlich					
	C gelegentlich					
	D selten					
	E unwahrscheinlich					
	F unvorstellbar					

1. Präventive Massnahmen

2. Ausmassmindernde Massnahmen

Risk matrix and measures

Structured proceeding towards new safety concept

- Analysis of existing operational experiences and identification of improvement potential
- Analysis of strength & weakness of measures
- Brainstorming for identification of additional measures
- Concretization of feasible measures
- Deeper investigation of significant fire scenarios including simulation of smoke spreading and movement of people
- Investigation of cost and advantages of individual measures
- Valuation of possible measures in respect to increase of safety and definition of priorities

Thorough analysis of constructional measures

- Technical and economic assessment of most significant measures
- Preliminary project of constructional measures.
- Thorough determination of cost and implementation schedule

TECHNICAL SOLUTIONS



Road / rail firefighting vehicle

Solutions and recommendations

- Definition of recommended measures
- Staging of investments
- Documentation of intermediate phases

Investigated individual measures (selection):

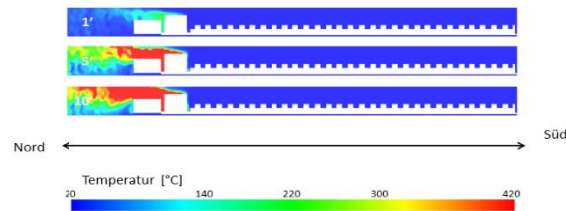
- Operational measures
- Organizational measures
- Improvement of rolling stock
- Preventive check of vehicles before entering the tunnel
- Fire extinguishing systems in tunnel and on train compositions
- Constructional measures to supporting self-rescue.
- Tunnel ventilation
- Train supervision and control
- Organization of an intervention if necessary

CHALLENGES

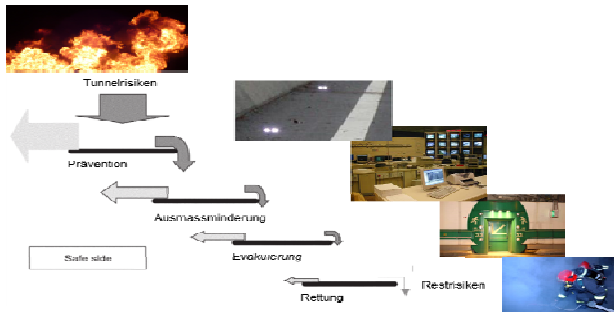


■ Passage of car train

LW schwer, Fahrtrichtung Süd 40 km/h - Temperatur

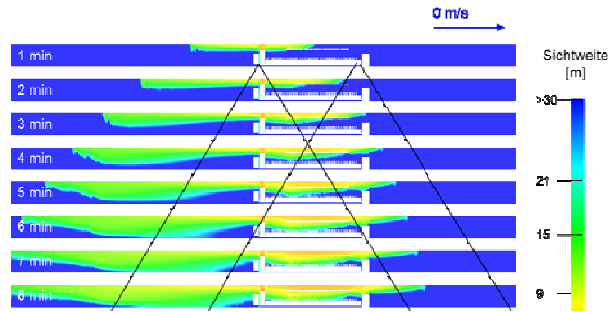


■ Fire / smoke spreading of a burning truck



■ Multilevel safety concept

TECHNICAL APPROACH



■ Smoke spreading of a halting train with ventilation

Häufigkeit	> 10 / 100 J	1 - 10 / 100 J	0.1 - 1 / 100 J	0.01 - 0.1 / 100 J	0.001 - 0.01 / 100 J	< 0.001 / 100 J
Verletzte	1 †	2 - 9 †	10 - 50 †	50 - 100 †	> 100 †	

Legende:
1 APZ Brand FW, LW in Brandlast
2 APZ Brand LW, grosser Brandlast
3 Brand Relierung

■ Risk matrix before / after implement. of measures

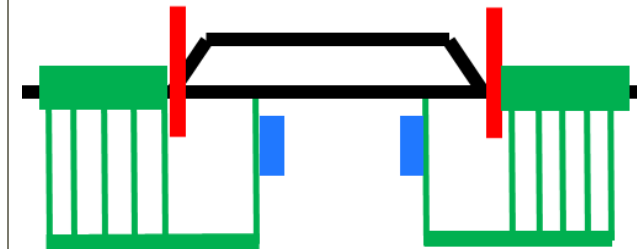
Risikokategorie	Akzeptanz
intolerabel	Muss ausgeschlossen werden.
unerwünscht	Darf nur akzeptiert werden, wenn die Risikominderung praktisch nicht durchführbar ist oder eine Zustimmung entweder des Bahnunternehmens oder der für die Sicherheit zuständigen Aufsichtsbehörde vorliegt.
tolerabel	Akzeptierbar bei geeigneter Überwachung und mit der Zustimmung des Bahnunternehmens.
vernachlässigbar	Akzeptierbar mit/ohne weitere Zustimmung des Bahnunternehmens.

■ Risk categories and acceptance levels

TECHNICAL SOLUTIONS



■ Passage of express train



■ Intersection area with protection systems



■ Fire fighting vehicle road / rail

INVOLVED KEY PERSONAL AMBERG



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