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

The Vereina tunnel is part a winter safe railway link between Klosters (Davos) and Sagliains (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**

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**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

**Concretezation 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

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**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

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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**

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
- Fire / smoke spreading of a burning truck
- Multilevel safety concept

### TECHNICAL APPROACH

- Smoke spreading of a halting train with ventilation
- Risk matrix before / after implement. of measures
- Risk categories and acceptance levels

### TECHNICAL SOLUTIONS

- Passage of express train
- Intersection area with protection systems
- Fire fighting vehicle road / rail
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