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Eidgenössisches Departement für  
Umwelt, Verkehr, Energie und Kommunikation

**Bundesamt für Verkehr**



# Safe Integration Gotthard Base Tunnel as part of the Railway Infrastructure

ERA Training in Budapest

27th June 2017

Juerg LUETSCHER Bundesamt für Verkehr



# Agenda

- Specification of Gotthard Base Tunnel
- Four phases of verification
- Operating concept
- Safety authorisation – Infra manager
- Safety certificate – Railway undertaking
- Experience – first six months of operation



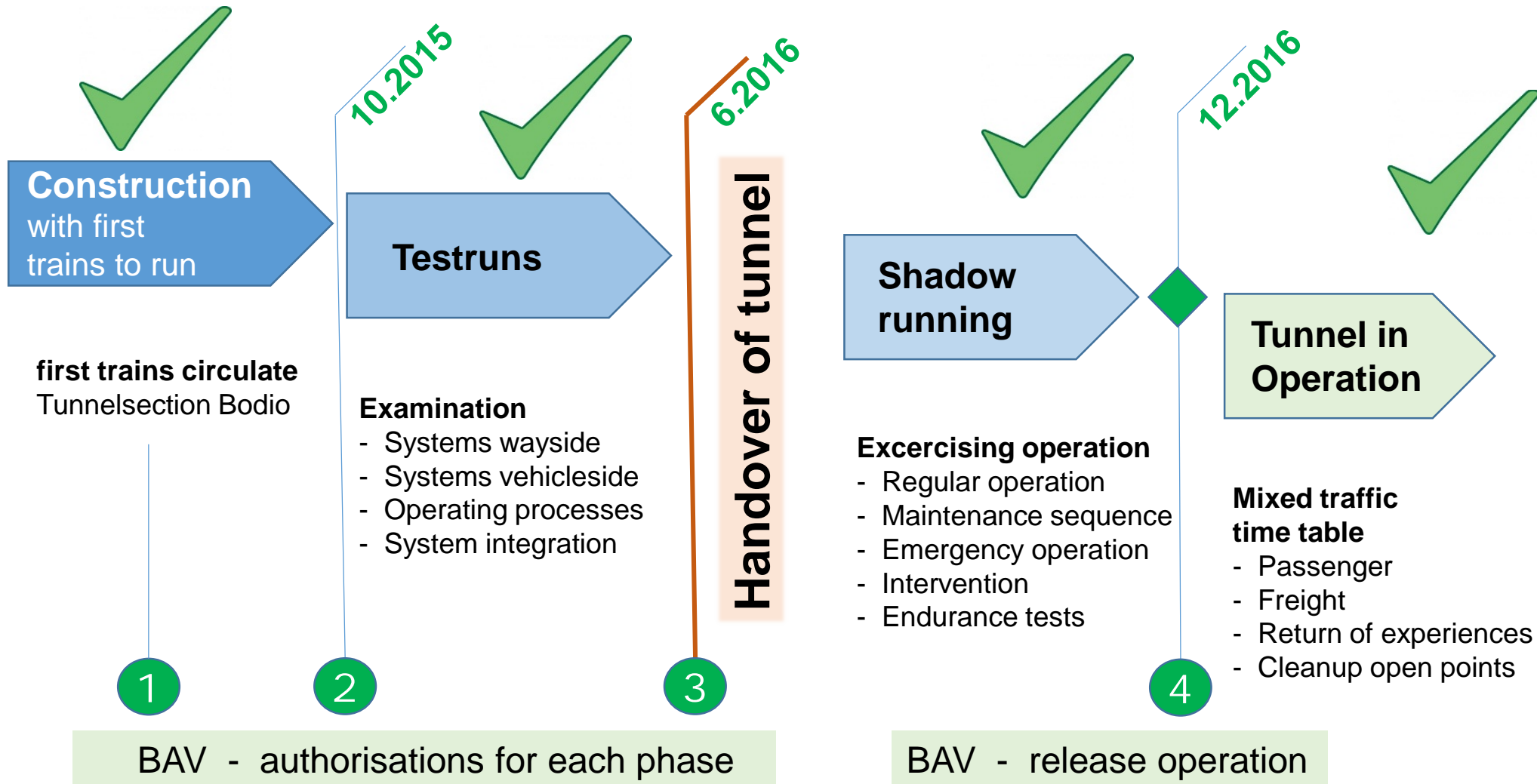
# Technical Specification Gotthard Base Tunnel



- Compatible to all rolling stock in conformity with TSI
- Qualified up to 250 km/h
- max. axle load: 25 t
- Pantograph contact strips: 1'435 mm and 1'600 mm
- ETCS L2 Version 2.3.0 d
- Loading gauge 4m corner height
- Train length: up to 750 m
- Freight Trains weight:  
N-S: 1600 To      S-N: 1300 To
- Timetable (sequence for 1/2h)  
1 IC-train (200km/h), 3 Freight trains (100km/h)



# Four Phases of Verification





# Verification of technical performance (1)



**Phase 1 – first trains to run:**

Testing of essential key elements of tunnel systems, done with testtrains

**Target:**

Verification of all subsystems and their performance, getting test results with the first finished section

**Procedure:**

Testruns with speed increased step by step  
Maximum speed of 200 km/h reached  
Measuring and Evaluation

**Organisation:**

Team of experts - constructor and inframanager



# Verification of technical performance (2)



## Phase 2 – Testruns:

Performance tests of tunnel systems done with testtrain  
DB ICE-S as reference train

## Target:

Verification that all subsystems fulfill the specification (TSI),  
Reference speed: 250 km/h

## Procedure:

Testruns up to 275 km/h  
Measuring and Evaluation  
Independent Validation of results

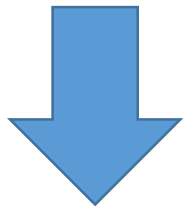
## Organisation:

Independent Assessment  
NoBo not used (Project of 1990)



# Handover of Tunnel to Inframanager

Gotthard Base Tunnel  
Construction Phase



1.7.2016

**Infra-Manager**

- Operating the Tunnel



- **Construction of tunnel completed**
- **Typetests demonstrated conformity with specification**



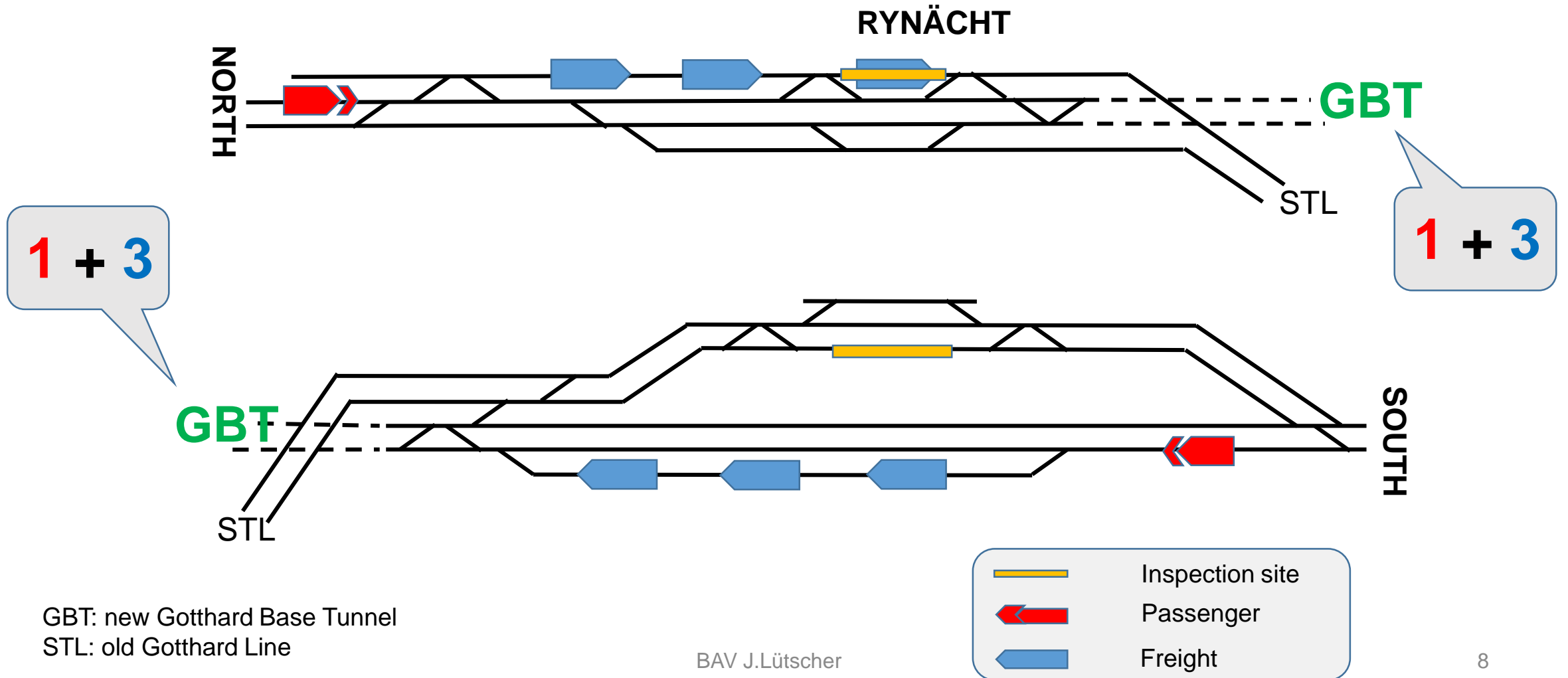
**Railway Undertaking**

- Operating Passenger Trains
- Operating Freight Trains





# Operating Concept







# Excercising Operation



## Phase 3 – Excercising Operation:

- Performing regular operation of tunnel
- Working maintenance sequences
- Performing emergency operation
- Accomplish intervention targets

## Target:

- Verification of operational performance
- Training operation staff

## Procedure:

Testoperation with typical sequences

## Organisation:

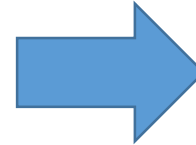
Employees of IM and RU  
NSA to inspect



# Starting timetable Operation

## Project of tunnel construction reaches milestone

- technical specification fulfilled
- Safety analysis completed

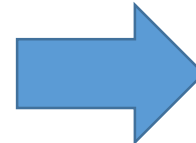


**Autorisation to operate**

**Conditions to comply**

## Safety Management System of undertaking updated

- Integration of new tunnel by IM completed



**Safety Authorisation for IM**



# Safety Authorisation for SBB-Infra (1)

## Requirements to operate Gotthard Base Tunnel:

- Operating long tunnel (>3km)
- Operating ETCS L2
- Training of responsible staff

## Competences of SBB-Infra while preparing to operate the new Gotthard Base Tunnel:

- All skills already established
- Lean process to expand safety authorisation, no SMS check required

## Work to do:

- Minimum work to validate competences to expand safety authorisation of SBB-Infra





# Safety Authorisation for SBB-Infra (2)

## Conclusion:

- Minimum work to validate competences to expand safety authorisation of SBB-Infra
- The close cooperation from Alptransit and SBB-Infra during the construction phase was the key issue for know how transfer

## Key aspect:

- Do all the subprocesses fit together ?
- Do they cover all specified requirements ?

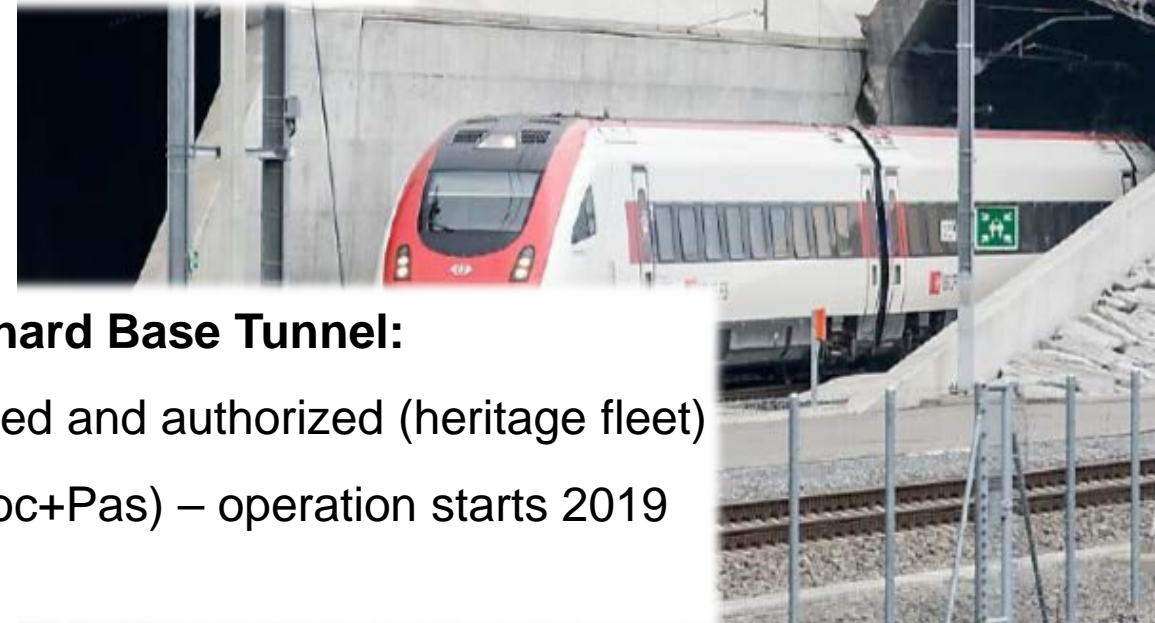




# Rolling Stock (1)

## Requirements for vehicles to operate through the Gotthard Base Tunnel:

- Firedetection (Traction + Passenger Compartments - TSI)
- Emergency Operation (15min after detecting fire - TSI)
- Overriding function of emergency brake - TSI
- Compatibility with ETCS L2 (using BL2 or BL3 - TSI)
- Aerodynamic behaviour (speed > 160km/h – NNTR-CH «single track tunnel»)












## Preparing rolling stock to operate through the new Gotthard Base Tunnel:

- 45 different existing vehicle types being upgraded, validated and authorized (heritage fleet)
- SBB EC 250 will be the first new train (conforme to TSI Loc+Pas) – operation starts 2019
- No specific requirements for freight cars (RIV, TSI)



# Rolling Stock (2)

SBB-P heritage fleet to be upgraded for Gotthard Base Tunnel

Re 460		13
Eurocity		54
EW IV		41
WRm		5
IC-Bt		14
ICN		18
ETR 610 1.S <sub>SBB</sub>		8
ETR 610 1.S <sub>TI</sub>		7
ETR 610 2.S <sub>SBB</sub>		8

Vehicle Type

Number

Risc Analysis showing non conformities



Mesures taken to improve situation



Demonstrate acceptable safety level



Authorisation of safety relevant modifications



# Safety Certificate for Railway Undertakings

## Requirements for Gotthard Base Tunnel:

- Operating trains in long tunnel (>3km)
- Operating trains on ETCS L2

## Railway Undertakings preparing to operate through the new Gotthard Base Tunnel:

- Rolling stock fullfills specified requirements (Long tunnels + ETCS)
- Staff graduated training (Knowledge of new line and operating rules)

## Conclusion:

- Validation of competences to expand safety certificate of railway undertaking is modular
- Shadow Running used for training of staff in a early phase



# 6 Months of Operation – Experience (1)

5 Freight Railway Undertakings operate their trains

10'706 Freight Trains in 6 months

1 Passenger Railway Undertaking operates its trains

7'024 Passenger Trains in 6 months

115 Slots used, 65% of the specified capacity used

Expected running speed and time schedule of all types of trains reached

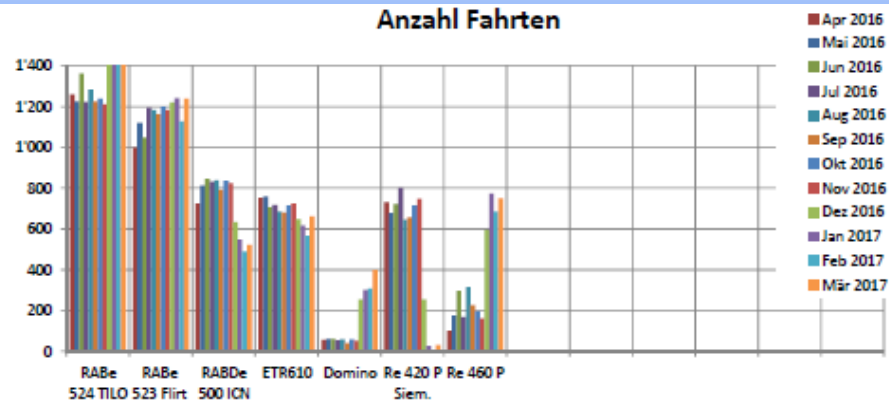






# Monitoring

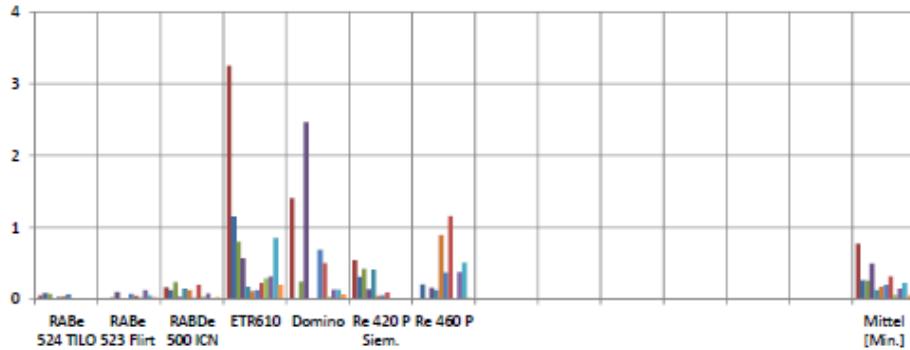
### Anzahl Fahrten



Running trips per vehicle type

monthly update

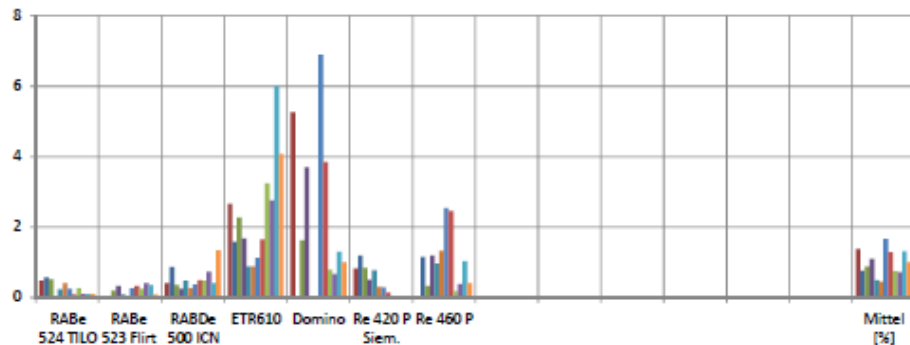
### Störungsminuten pro Fahrt



Dealy accumulated per vehicle type

Project team analyses data

### Prozentsatz der Fahrten mit Störungen [%]



Percentage of failed trips per vehicle type



# 6 Months of Operation – Experience (2)

## **Operation runs with the expected quality**

- 99% of all planned trains rolled through the Base Tunnel as foreseen

## **Intervention to rescue a stalled train takes place as defined**

- 14 Interventions using the emergency trains (LRZ)
- Target fulfilled: 45 Min to reach the stalled train
- Target fulfilled: 90 Min to evacuate the passengers out of tunnel

## **Remaning restrictions due to FOT conditons**

- Timetable: Hourly 2 Passenger + 4 Freight trains (6 Freight trains will be final target)
- Speed restrictions at north portal
- Freight Trains limited to 620m in place of 750m



# 6 Months of Operation – Experience (3)

## Elimination of operational restrictions by improving Infrastructure until 2018

- Track-Topology at Rynächt to be improved (Speed Restriction)
- Powersupply and Catenary to be improved (Speed + Capacity Restrictions)
- Trainprotection Systems to be improved (Operation)

## ETCS Problems (Onboard)

- Bombardier EBICAB (Problems discovered during operational tests – solved in 2016)
- Alstom Onboard (Failures in odometry leads to stalled trains – open point)
- Alstom Bistandard (Failure on SCMT-function leads in ETCS-mode to emergency brake)
- ETCS L2 brake application could lead to overheating (Thus - Operation with restricted speeds)



# 6 Months of Operation – Experience (4)

## **Sand and dust in tunnel**

- Sand and dust left from the construction phase (Despite extensive cleaning)
- Lost load from open wagons running through the tunnel (Measure: Train speed reduced)
- Observation: Locomotives «sandblasted», air filters soiled, large dust deposit in vehicles

## **Performance problems of rolling stock**

- Systematical monitoring of all operated vehicle types shows weak points
- Vehicle keeper work together with manufacturer to improve performance



# Construction of Ceneri Base Tunnel

Using the same principles as for Gotthard Base Tunnel

Applying similar safety measurements

This Tunnel will go into service 2020

north portal  
Ceneri base tunnel



# Conclusions



- Safe integration of new tunnel was a very demanding task
- Project could be realized as planned
- Validation showed appropriate safety level
- Operational service started with minor restrictions
- Improving process during operation closes open points
- Close cooperation between all participants is the key to success