AUSTRIA VIENNA 2024 IRSC INTERNATIONAL Railway Safety Council

Innovative Safety Systems for Austrias Super-Long Railway Tunnels

Florian Diernhofer

17-21 Sept. 2024

Vienna, Austria
Aula der Wissenschaften

World‘s longest railway tunnels

2024

What about Austria?

1			
2			
3	Gotthard Base Tunnel	57,10 km	Switzerland
4	Seikan Tunnel	53,85 km	Japan
5	Eurotunnel	50,45 km	GBR / FRA
6	Yulheaon Tunnel	50,30 km	S-Korea
7	Lötschberg Base Tunnel	34,60 km	Switzerland
8			
9	New Guanjiao Tunnel	32,65 km	China
10	Guadarrama Tunnel	28,40 km	Spain
11	Western Qinling Tunnel	28,24 km	China
12	Taihangshan Tunnel	27,85 km	China
13			
14	Hakkōda Tunnel	26,45 km	Japan

A) Mont-Cenis Base Tunnel

B) Semmering Base Tunnel

C) Brenner Base Tunnel

D) Koralm Tunnel

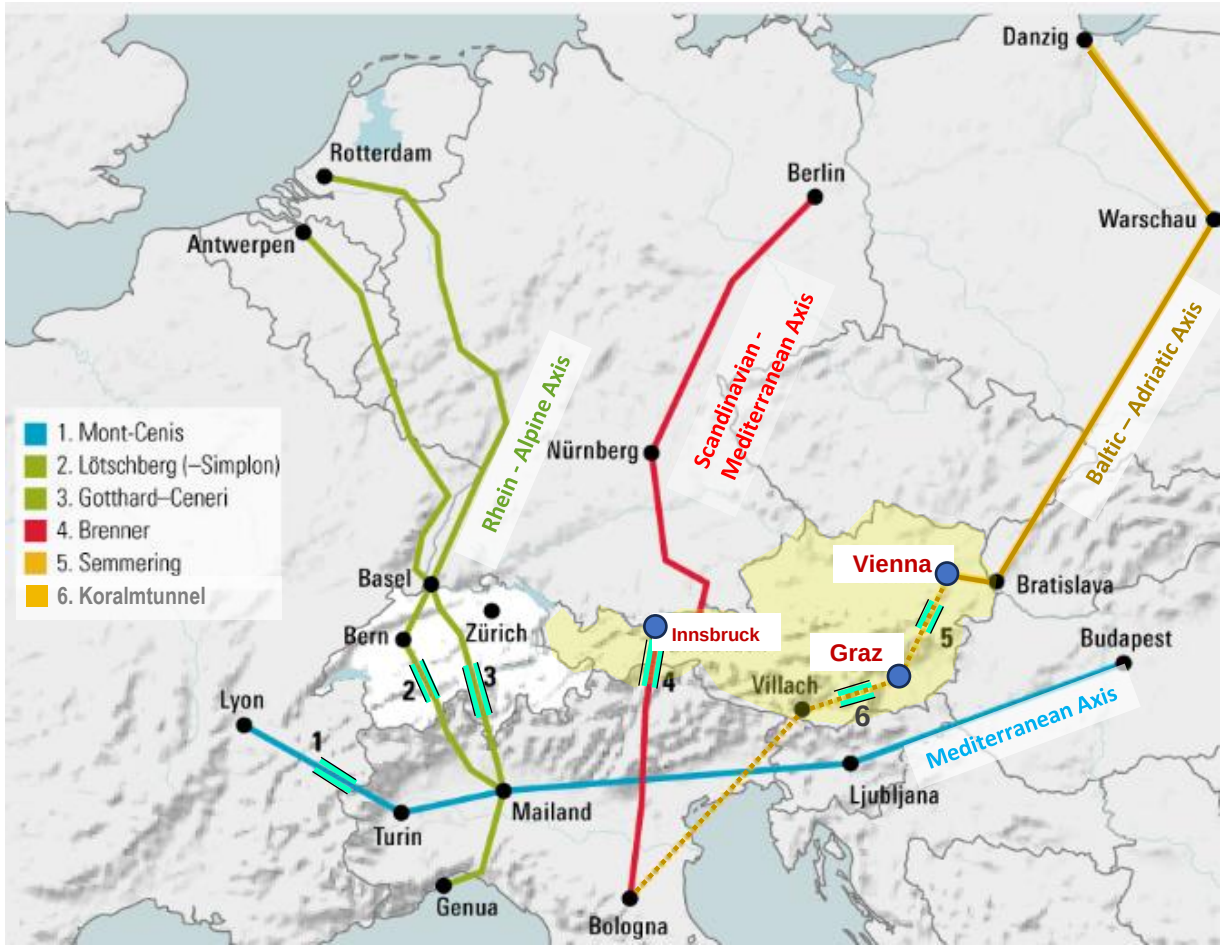
Assign according to their length!

AUSTRIA VIENNA 2024 IRSC INTERNATIONAL Railway Safety Council

Transalpine TERN Axes

Current & future superlong tunnels on the Alps-crossing axes of the Trans-European Railway Network

- Baltic – Adriatic Axis
- Mediterranean Axis
- Skandinavien – Mediterranean Axis
- Rhein – Alpine – Axis



… Tunnel

World‘s longest railway tunnels

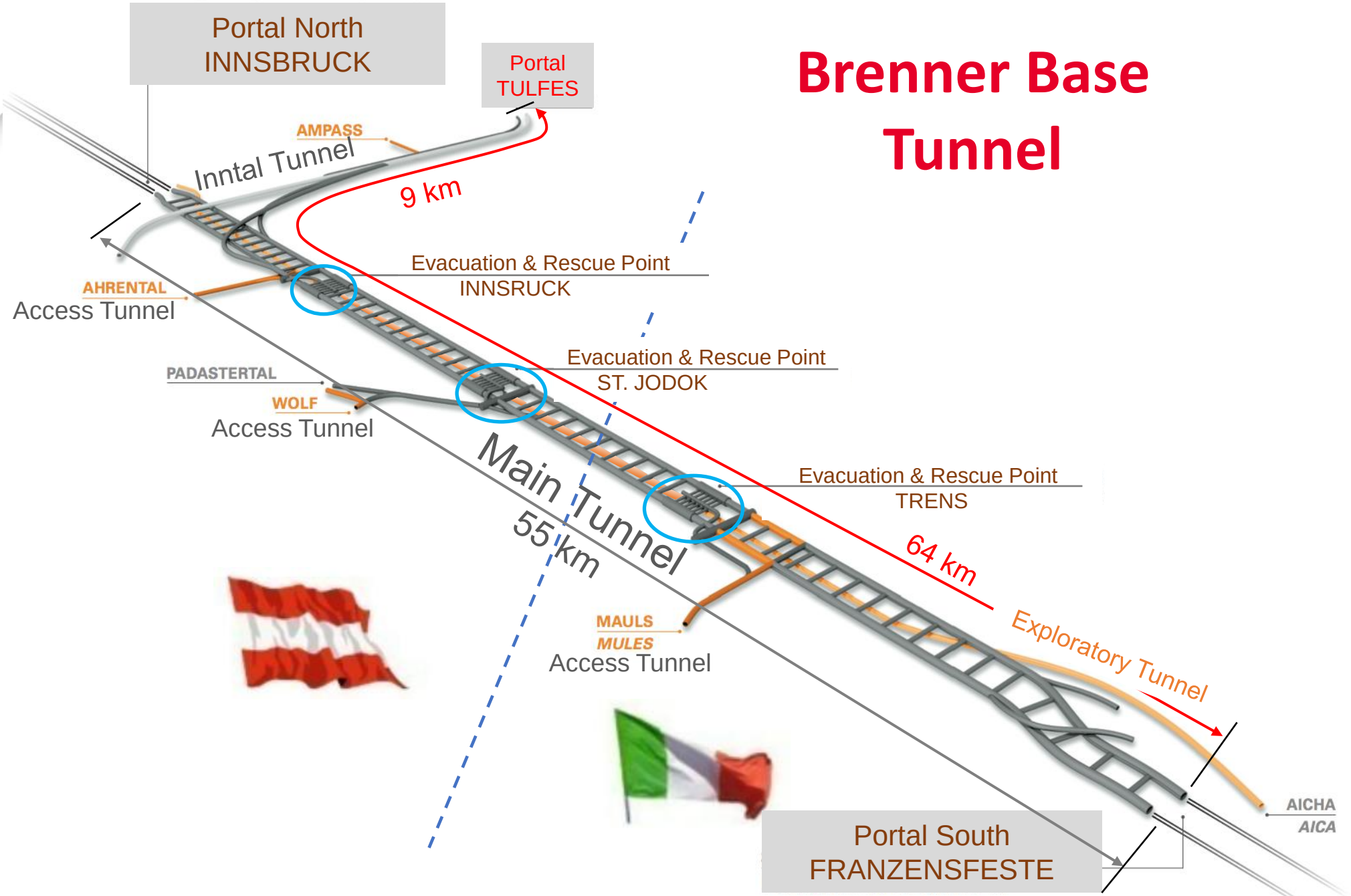
> 2032

What about Austria?

1	**C) Brenner Base Tunnel**	**64 km** (55+9km)	**AUT** / IT
2	**A) Mont-Cenis Base Tunnel**	57,50 km	FRA / IT
3	Gotthard Base Tunnel	57,10 km	Switzerland
4	Seikan Tunnel	53,85 km	Japan
5	Eurotunnel	50,45 km	GBR / FRA
6	Yulheaon Tunnel	50,30 km	S-Korea
7	Lötschberg Base Tunnel	34,60 km	Switzerland
8	**D) Koralm Tunnel**	**33,00 km**	**AUT**
9	New Guanjiao Tunnel	32,65 km	China
10	Guadarrama Tunnel	28,40 km	Spain
11	Western Qinling Tunnel	28,24 km	China
12	Taihangshan Tunnel	27,85 km	China
13	**B) Semmering Base Tunnel**	**27,30 km**	**AUT**
14	Hakkōda Tunnel	26,45 km	Japan

AUSTRIA VIENNA 2024 IRSC INTERNATIONAL Railway Safety Council

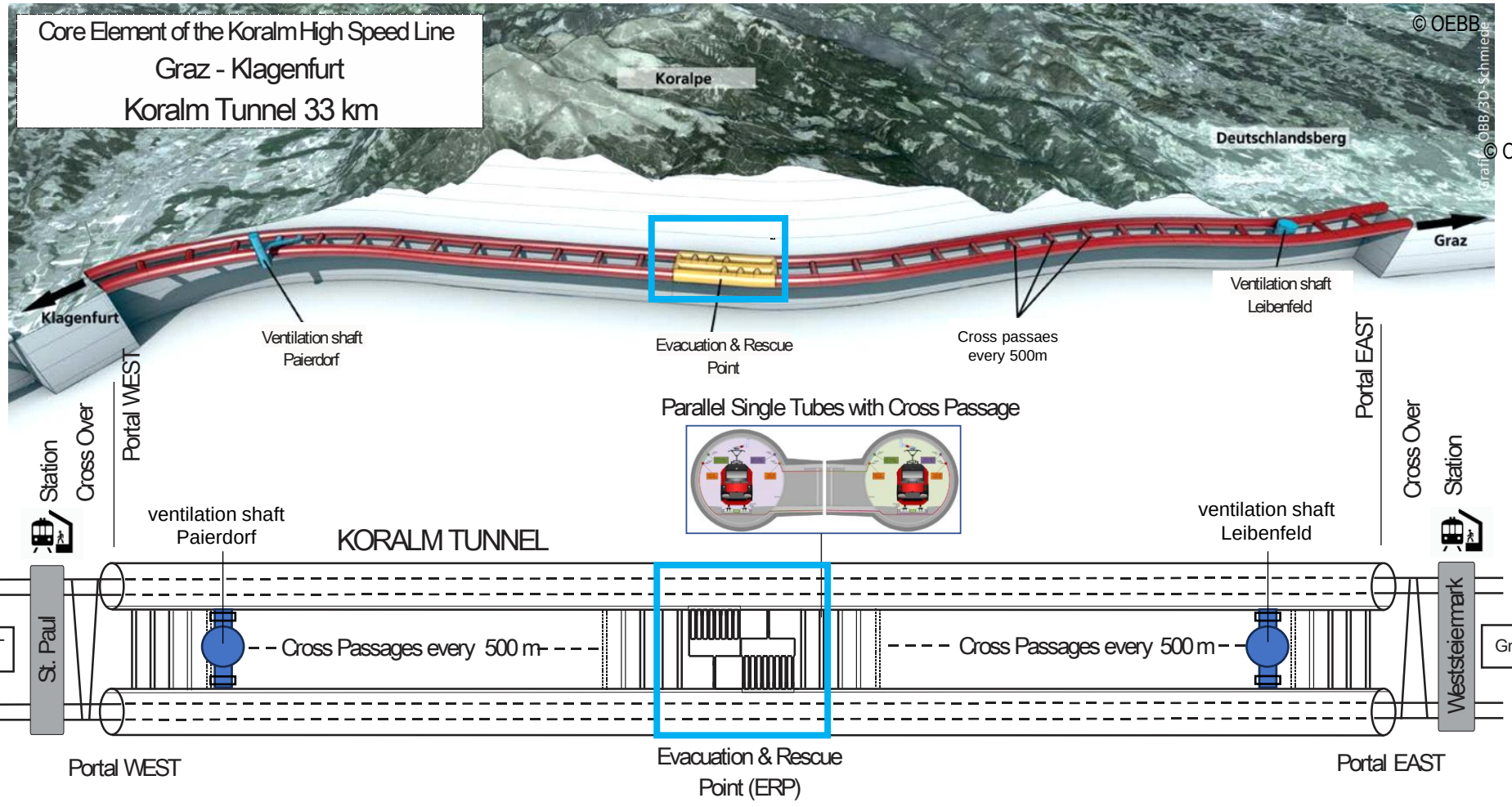
Brenner Base Tunnel



Koralm Tunnel

- Twin-tube single-track tunnels connected via cross-passages at regular distances (500m)
- Evacuation & Rescue Point (EVRP) approx. in the middle of the tunnel
- High-pressure water mist system in the EVRP
- Mechanical ventilation for pressurizing the safe areas (safe tube, EVRP)

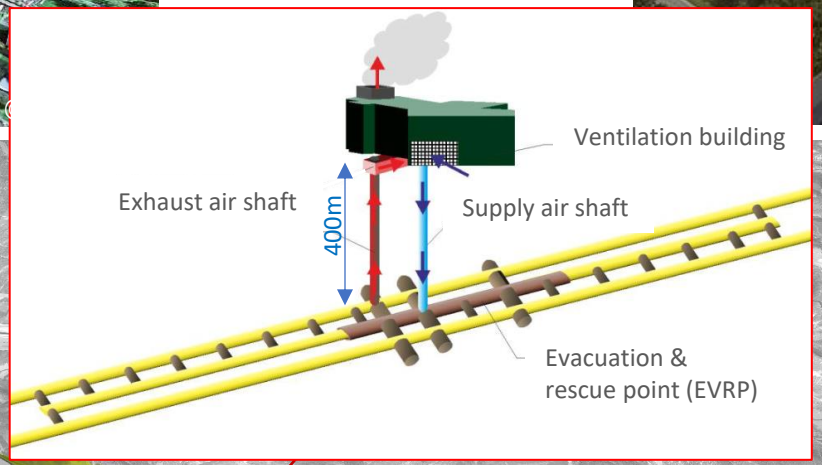
Tunnel system

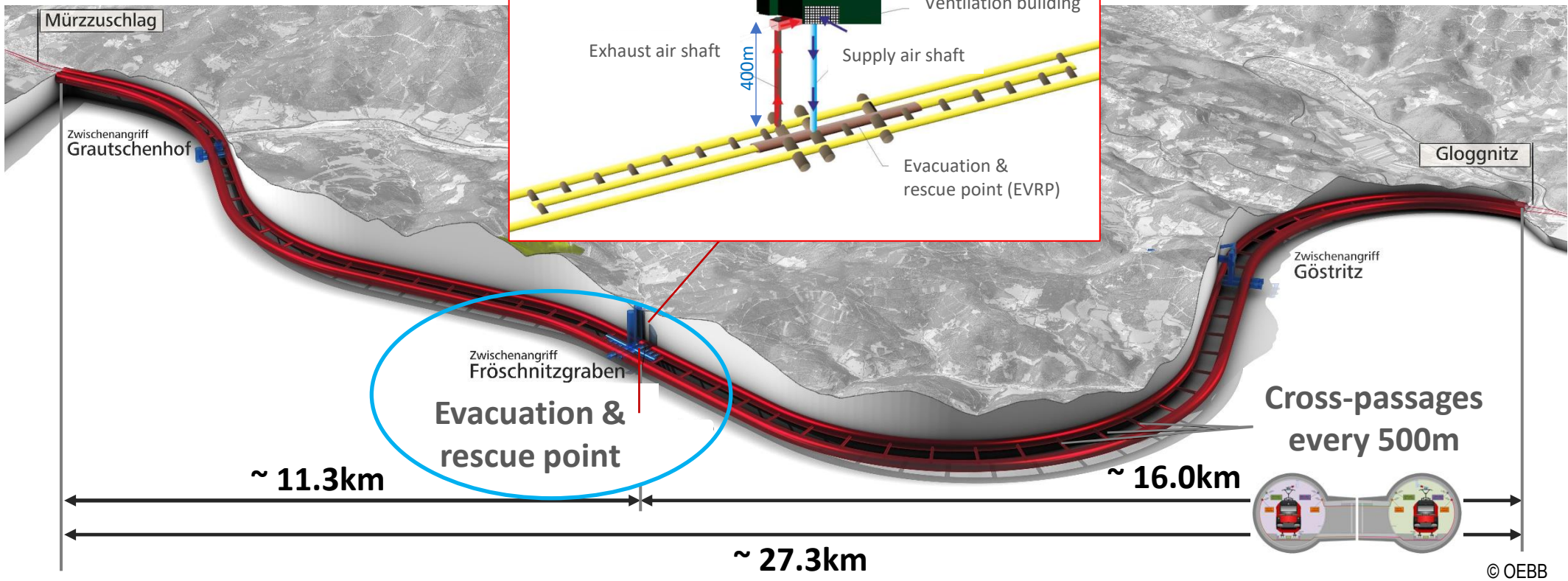


Semmering Base Tunnel

Portal East
MÜRZZUSCHLAG

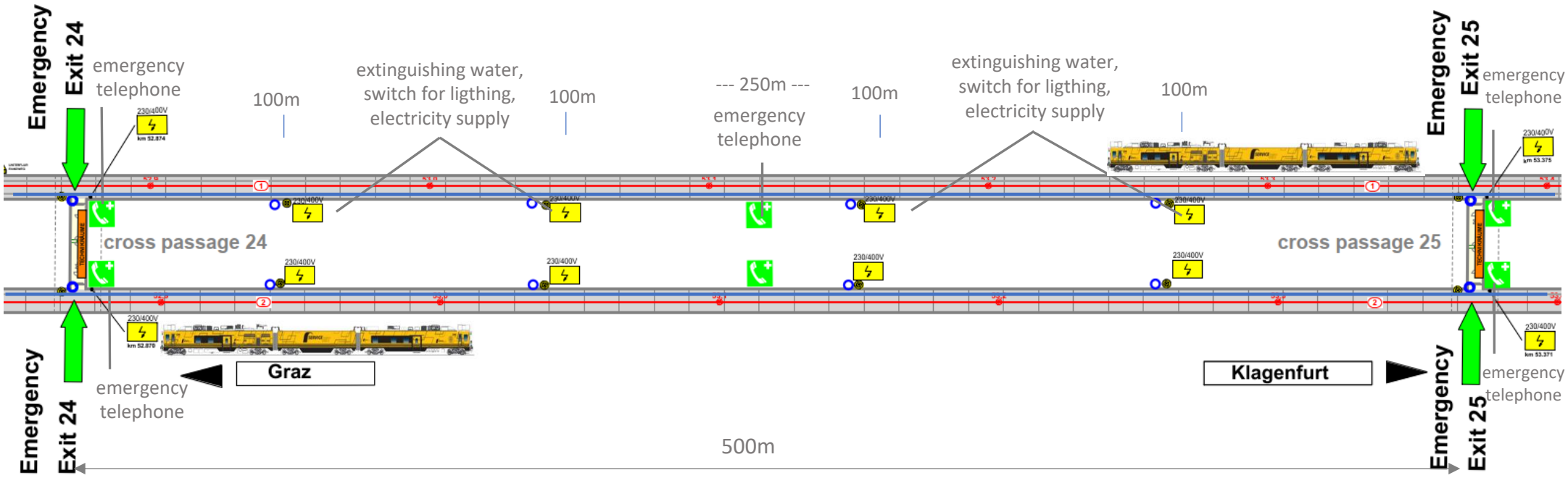
Portal West
GLOGGNITZ





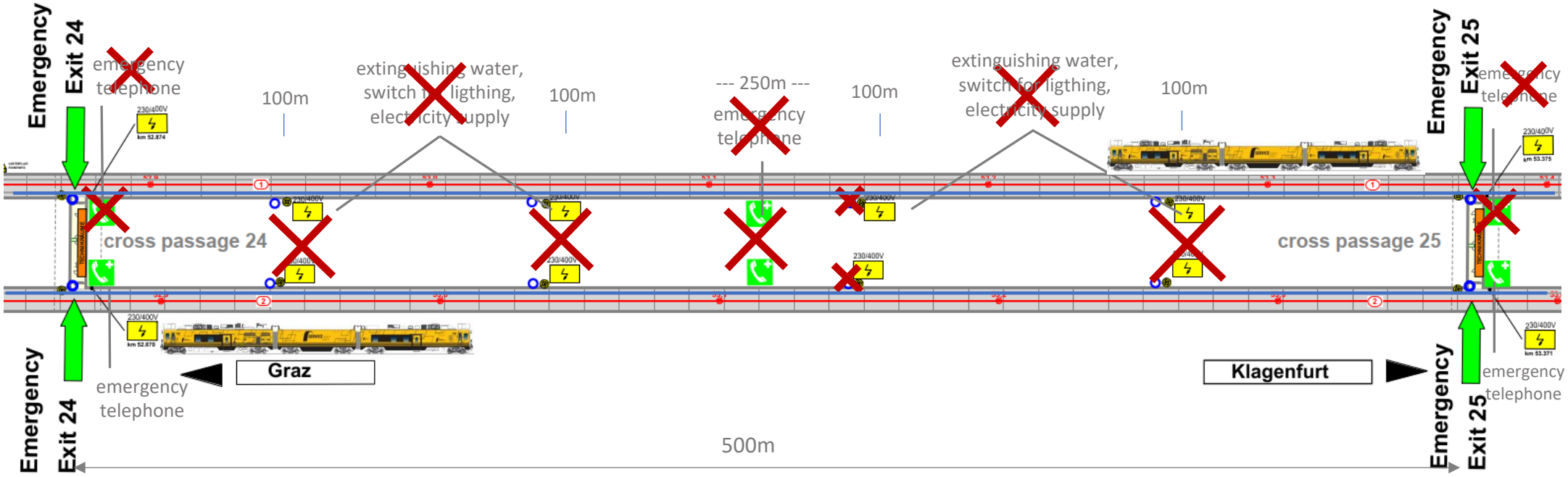
Tunnel safety vs. operational availability

- Totally compliant with the common guidelines???



Tunnel safety vs. operational availability

- **Totally compliant with the common guidelines??? → NO**
- **Deviations from guidelines**, coordinated with authorities & emergency services



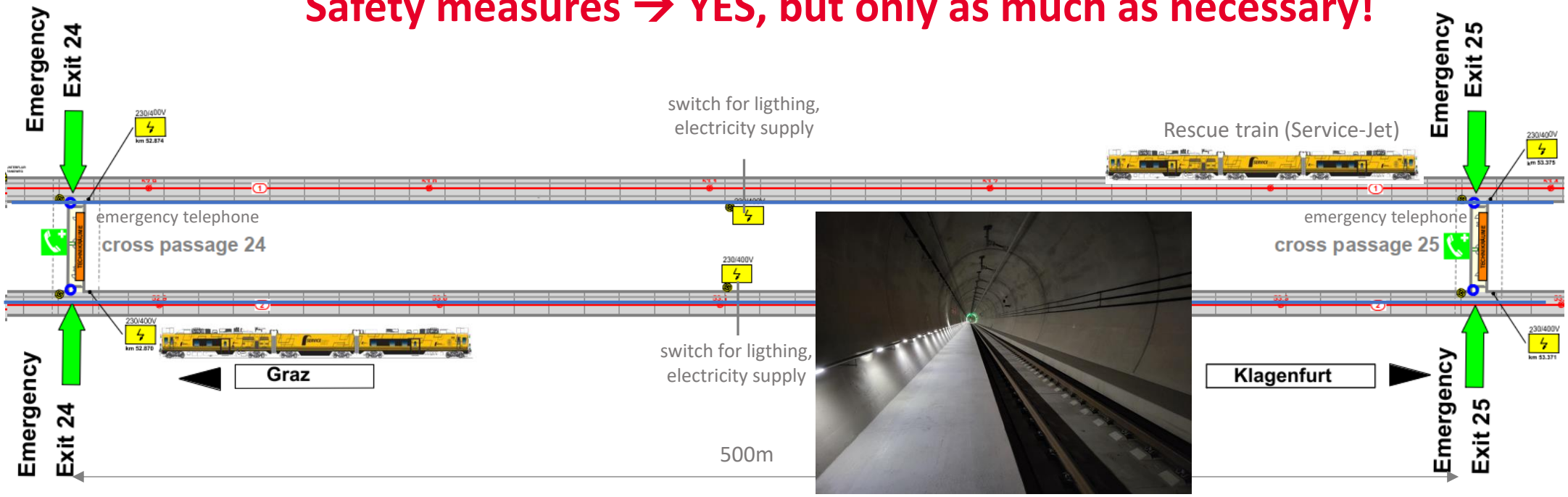
Tunnel safety vs. operational availability

- **Totally compliant with the common guidelines???**
- **Deviations from guidelines**, coordinated with authorities & emergency services

  → **Reduced maintenance of tunnel equipment in driving tubes,**

  concentration of equipment in cross passages + Rescue train (Service-Jet)!

Safety measures → YES, but only as much as necessary!



Evacuation & Rescue Points – Why?

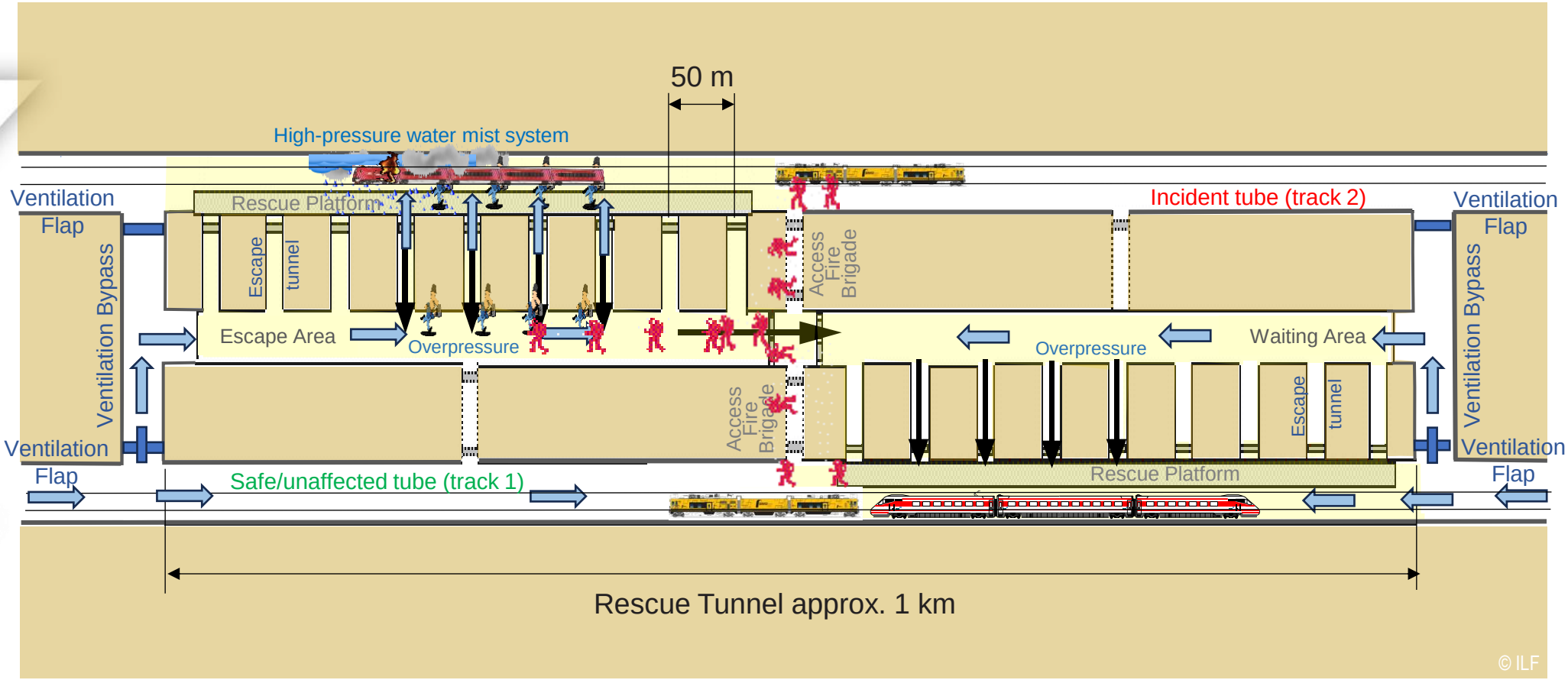
Technical Specification Interoperability - Safety in Railway Tunnels:

'If a railway tunnel is longer than 20 km an underground evacuation and rescue point is required'.

- **Primary objective of a burning train**
  Should leave the tunnel if possible
- **Very long tunnels (>20 km)**
  Likelihood of an uncontrolled stop increases significantly
  - **Evacuation**
    Travellers can be evacuated to a safe area
  - **Rescue & fire fighting**
    Appropriate firefighting equipment

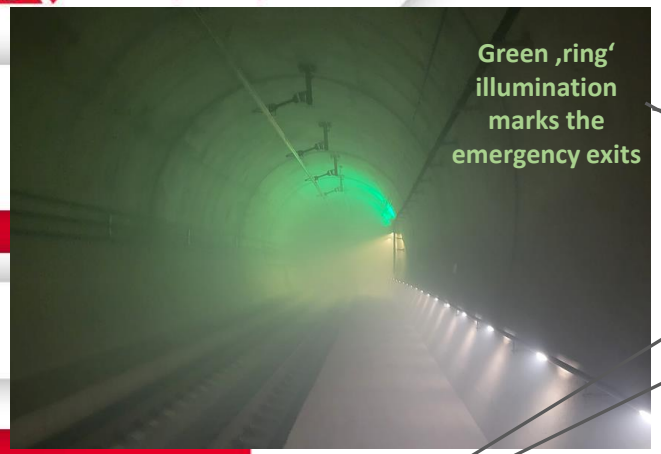
Subsurface Evacuation & Rescue Point

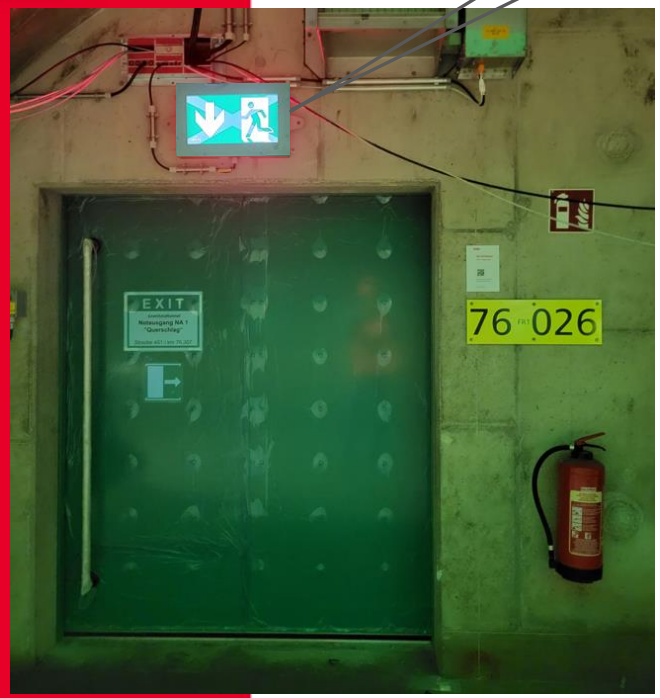
Evacuation Procedure (example Koralm Tunnel)

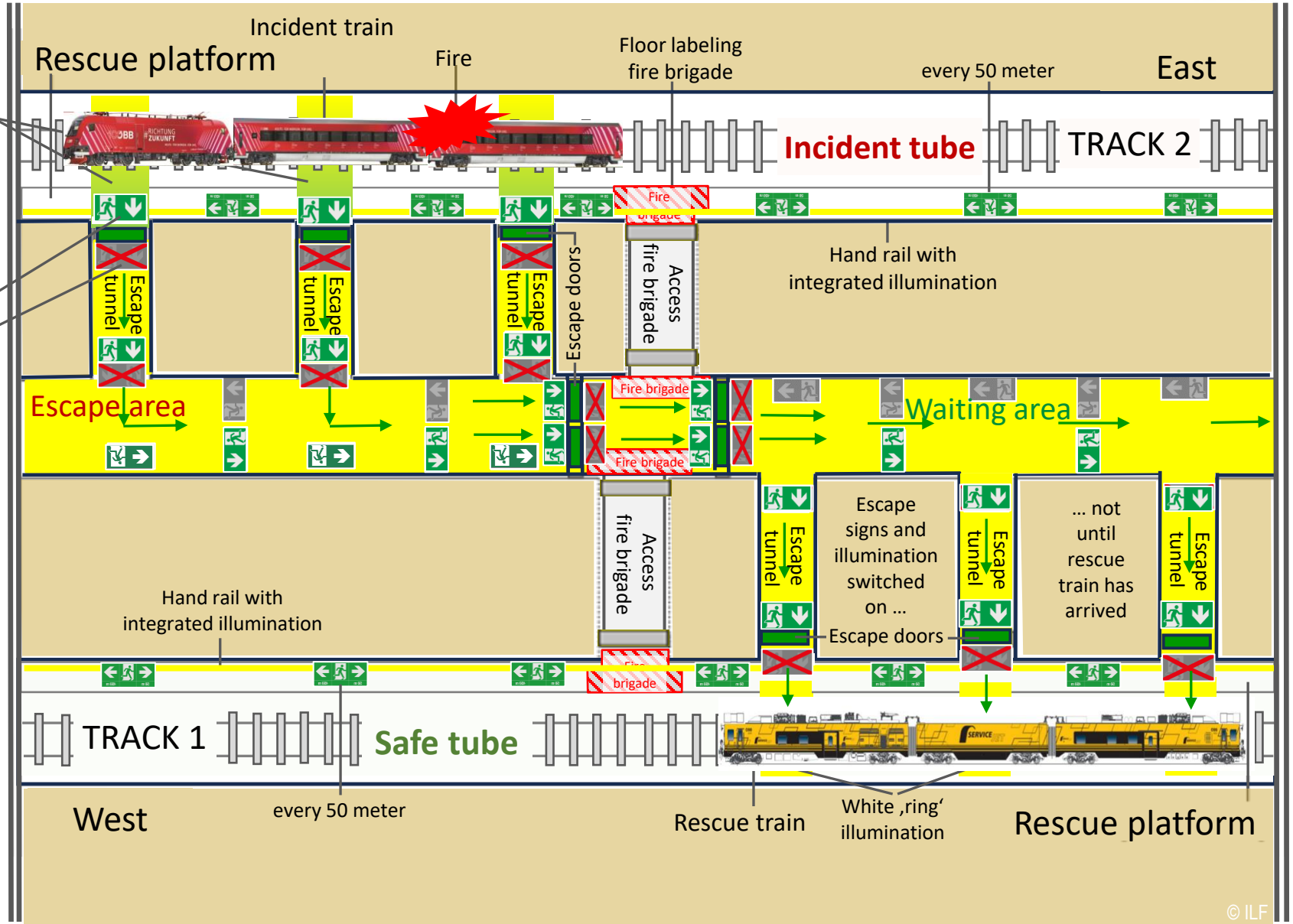


AUSTRIA VIENNA 2024 IRSC INTERNATIONAL Railway Safety Council

Emergency signaling & ligthing







Evacuation Simulation at the Rescue Point

- **Escape doors every 50m** (width 1,40 m / height 2,20 m)
- **Elevated rescue platform** (55 cm above tracks, width about 2,20 m)

- **Train set:** Double 7-car ÖBB-RailJet (14 coaches + 2 traction), L = 410m
- **High occupation degree:** 900 Persons
- **Door exit time:** 2 sec/Pers

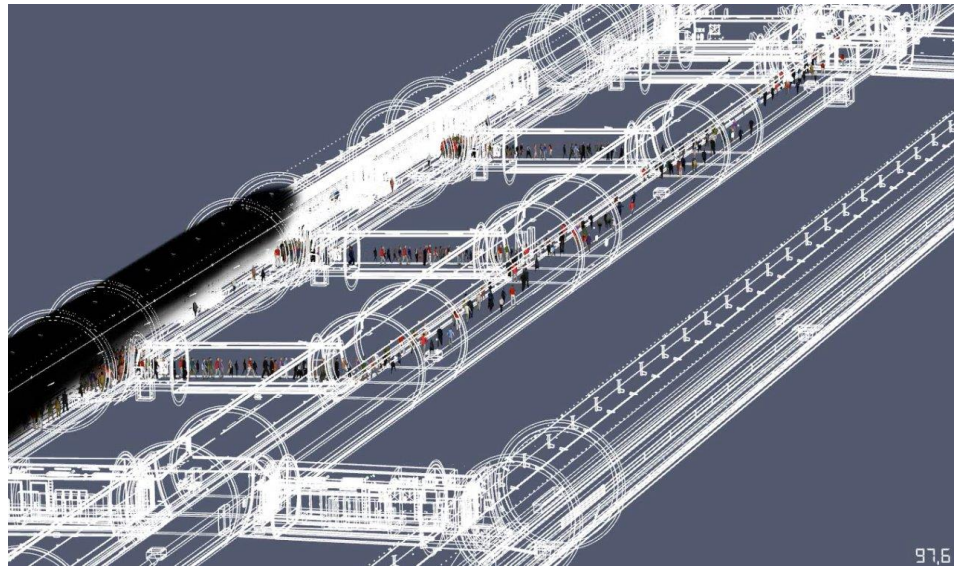
- **Different groups of people:**
  Max. walking speeds depending on age & gender

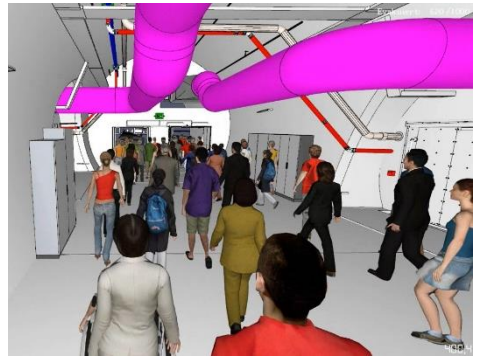
Group of persons (sex, age)	**Distribution of age** (group of persons)	**Maximum walking speed**
Male < 30 years	17 %	1,10 - 1,60 m/s
Male < 30 years	16 %	0,80 - 1,39 m/s
Male 30 - 50 years	14 %	1,30 - 1,48 m/s
Female 30 - 50 years	14 %	0,95 - 1,24 m/s
Male > 50 years	18 %	1,00 - 1,29 m/s
Male > 50 years	21 %	0,75 - 0,95 m/s

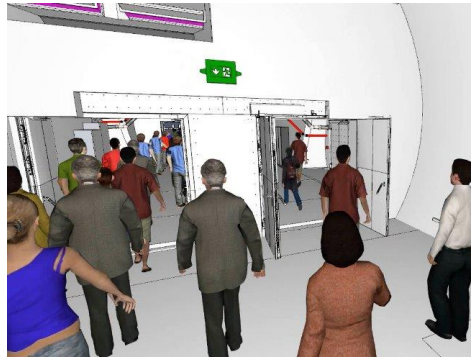
Software Pathfinder by Thunderhead Engineering, USA

AUSTRIA VIENNA 2024 IRSC INTERNATIONAL Railway Safety Council

Evacuation Simulation at the Rescue Point







Florian Diernhofer
florian.diernhofer@ilf.com
T +43 512 2412 4221
M +43 699 14530 231

AUSTRIA VIENNA 2024 IRSC INTERNATIONAL Railway Safety Council

Thank you for your attention!