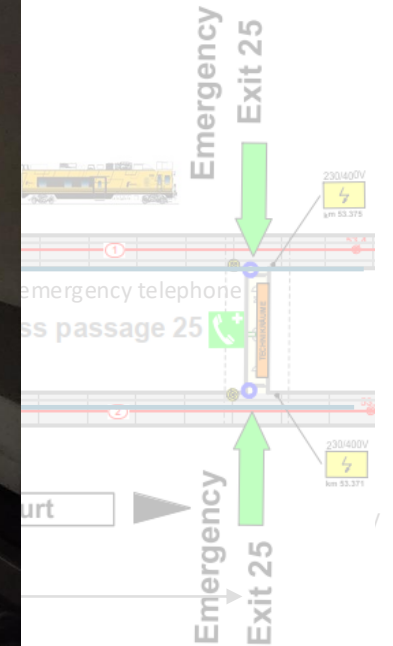
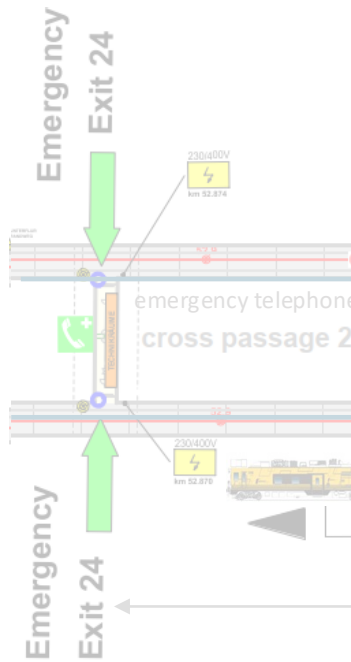




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Tunnel Safety **versus** Operational Availability

- Common
- Innovative intervent



Potential savings in maintenance

- **Replacement of the fixed fire water pipe by the Service-Jet**

- Guideline: every 125m
- Koralmtunnel: - → minus ca. 200h/year

Fire hydrant



- **Omission or reducing of devices with questionable benefits**

- **Power socket / Light switch**

- Guideline: every 100m
- Koralmtunnel: every 500m/250m → minus ca. 335h/year

- **Communications**

- Emergency telephones:

- Guideline: every 250m
- Koralmtunnel: every 500m → minus ca. 17h/year

- Analog radio (fire brigade):

- Harmonisation of different radio systems used by the federal states → minus ca. 110h/year

Light switch

Power socket

Emergency telephone

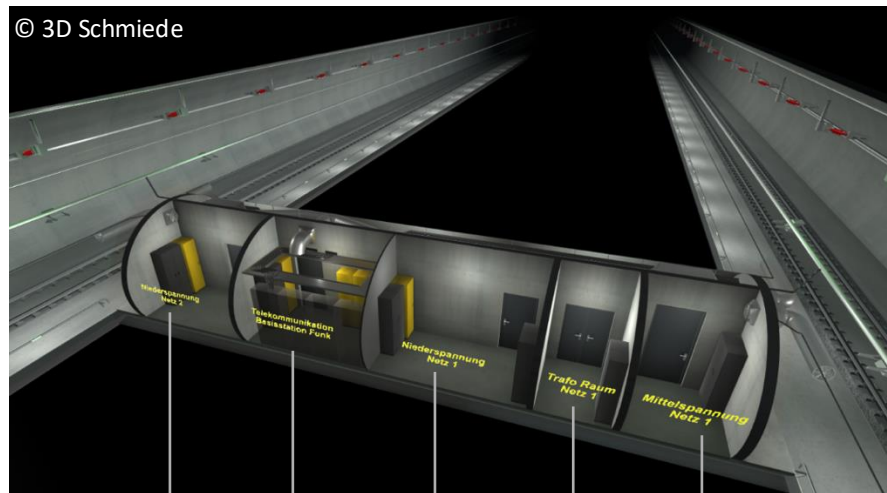


in total savings of ca. -660h*/year

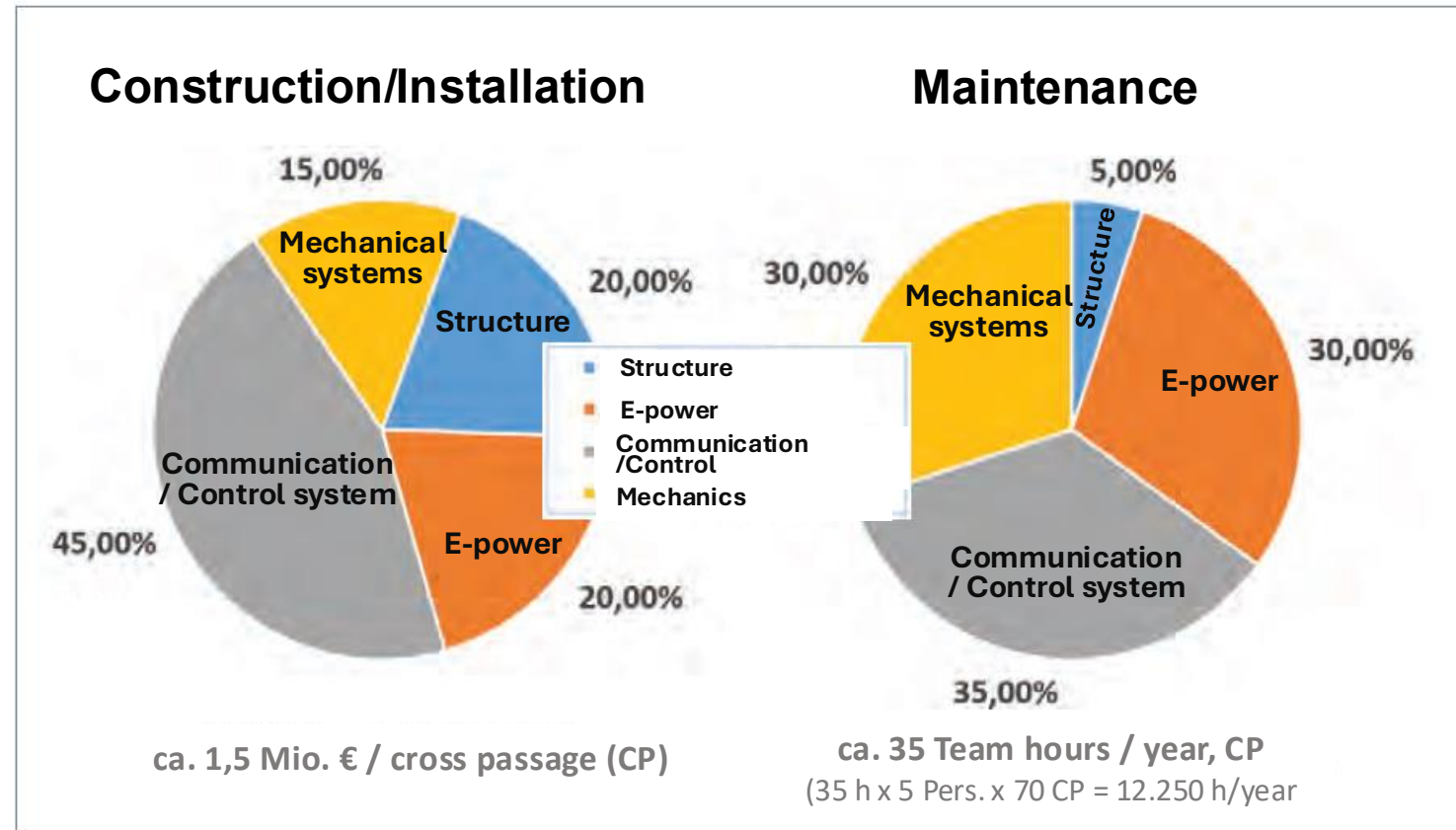
* hours per maintenance team (3 pers)

Construction vs. Maintenance acc. to subjects areas

- Efforts per cross passage → telematics and control systems are the key drivers
 → especially during installation, but also during maintenance



low voltage network 2
 Telematic
 low voltage network 1
 Transformer room network 1
 Medium voltage network 1



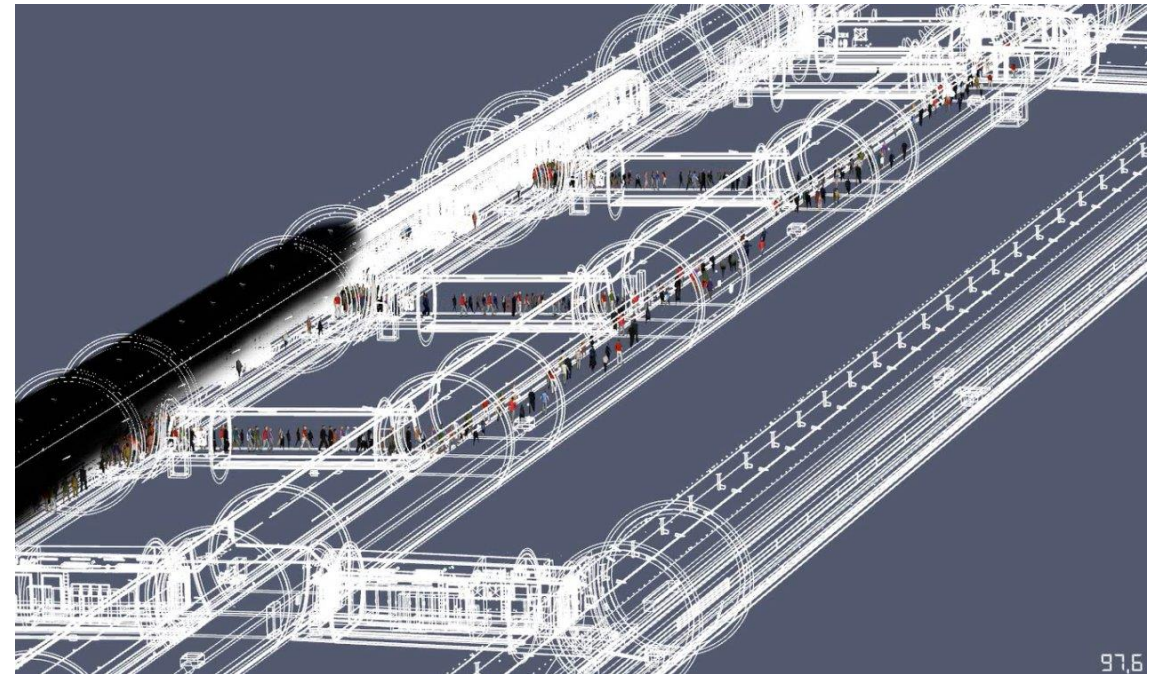
The Service-Jet

- Fire fighting & Evacuation Support
 - 3 kinds of traction power: Catenary / diesel / battery
 - Top speed 160 km/h / up to 40'000 liters of fire water
 - 2x2 jet fans on the roof (smoke & heat protection)
 - Filter system cleans air / overpressure prevents smoke
 - LP water (10 bar) / HP water (100 bar) / outer shell wetting
 - Evacuation capacity up to 330 people
- Technical and Maintenance Support
 - Can tow (broken-down) trains weighing up to 2,000 to
 - Maintenance "Taxi": Transport of teams and materials



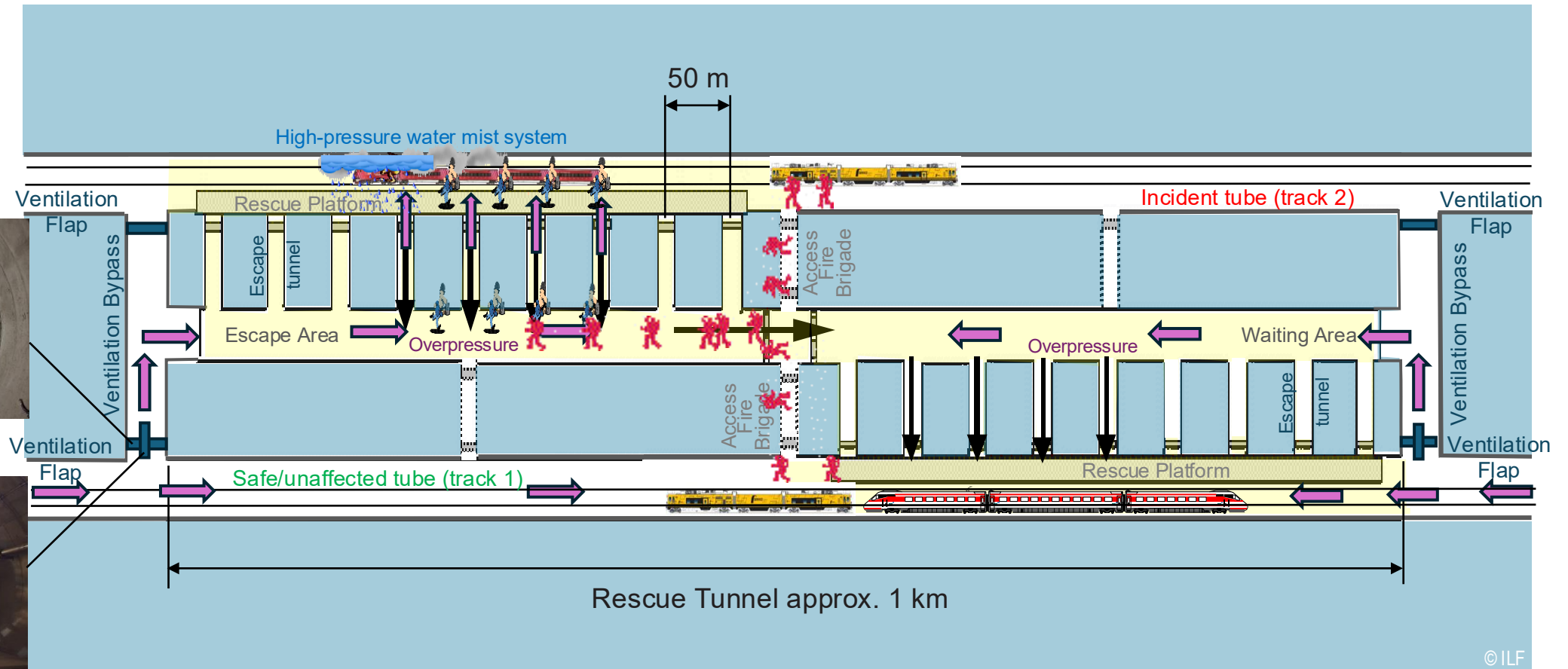
Subsurface Evacuation & Rescue Point – Why?

- Technical Specification Interoperability (EU) - Safety in Railway Tunnels:
‘If a railway tunnel is > 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 (EvRP)

- Evacuation Procedure



Escape Doors (Sliding Doors)

- Requirements

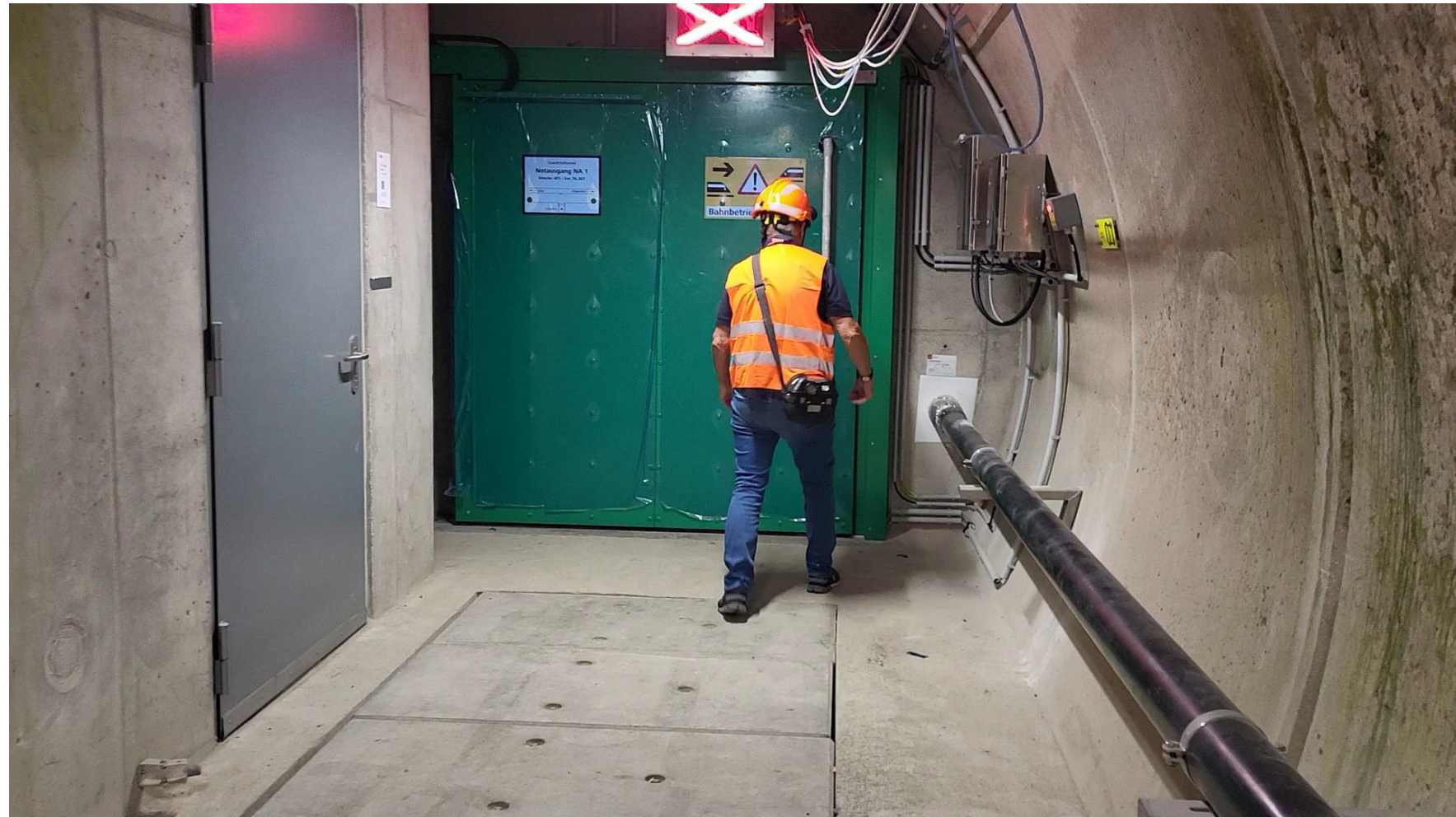
- Self-closing for forming fire compartments
- Stable & solid due to pressure effects
- Simple operability
- Low opening forces
- Clear description of the functionality

→ additional sign:



Escape Doors (Sliding Doors)

- Demonstration
 - The solid construction requires slow opening & closing processes
 - An immediately door closure would strongly counteract a smooth evacuation
 - Need for defined 'hold-open times', which have been determined using evacuation simulations





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Conclusion

- The realization of very long tunnels requires ...
 - a critical examination of the normally applied guidelines
 - advanced technologies and proper concepts, like the EvRP, HPWMS, ... - to cover the large distances and time-consuming access routes
- The advanced technologies should be combined with 3D-visualization & evacuation simulations
 - to specify time-relevant aspects of the emergency program, e.g. design and programming of escape doors, water mist system, ventilation, ...
 - to enable a proper installation design,
 - to train rescue teams & tunnel personnel



Thank you for your attention!

