

Brief overview

Key conclusions and recommendations

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WORLD ROAD ASSOCIATION
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International
**Conference on Road Tunnel
Operations and Safety**
3rd - 5th October 2018 LYON CONVENTION CENTRE - FRANCE

Register online www.tunnel-conference-lyon.com

SUPPORTED BY



Main objectives of the conference

- Promote the latest knowledge on current key issues
- Facilitate technical discussions and debate amongst industry & tunnel community stakeholders.



Conference web site:

<https://www.tunnel-conference-lyon.com/en/>

Conference programme (first 2days)

4 Technical sessions

- Safety management tools and systems
- Sustainable operation
- Safety systems and equipment
- Future tunnel safety challenges

2 round table discussions

- Safe operation of road tunnels
- Technical equipment-current practices and perspectives



Conference programme (3rd day)

4 Technical visits:

- Croix Rousse
- Mont Blanc
- Fréjus
- A 89



Contributions of the tunnel community



Participants

- **Conference: 330 participants**
- **Represented countries: 35 (17 non EU)**
- **Exhibitors: 33**
- **Technical visit participants: 130**
- **Very positive feedback:**
 - High-level speakers, representatives of the tunnel community
 - quality and content of the presentations
 - lively & interactive discussions

Content of the presentations (Brief overview)

4 technical sessions

1. Safety management tools and systems
2. Sustainable operation
3. Safety systems and equipment
4. Future tunnel safety challenges






1 - Safety management tools and systems

- Tools for safety management - Effectiveness of risk mitigation measures for road tunnels - Bernhard KOHL - Co-leader of PIARC WG 2 on Safety - Austria
- **Benchmarking safety management systems - Potential use for road tunnel operation - Eric PREMAT & Marie-Noëlle MARSAULT - Member of PIARC WG 2 on Safety - France**
- Overview of tunnel safety measures in Japan – Various attempts made by the East Nippon Expressway Company - Atsushi ICHIKAWA - East Nippon Expressway Company - Japan



1 – TUNNEL SAFETY APPROACH

In France, regulations in force since 2000 provide elements enabling the implementation of a safety management system (SMS):

- ✓ Involvement of all stakeholders with clearly defined responsibilities 
- ✓ A technical framework and risk analysis methods 
- ✓ Safety verification procedures from the tunnel's design stage and throughout its lifespan
- ✓ Feedback from operators (events, technical incidents and safety exercises) 

1 –What is a SMS?

Structured approach to safety management

- Establish the links between existing regulations and put them into perspective
- The basis for a management system which aims to achieve the **continuous improvement of safety for operators and all other stakeholders involved**



This does not imply that tunnels were previously not operated safely!

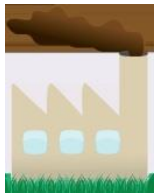
1 – SMS BENCHMARKING

Focused on 6 existing SMS in:

- **transport systems:** civil aviation, rail transport, urban guided transport, cable cars in mountainous areas



- **industry:** nuclear plants, classified facilities for protection of the environment



Analysis of SMS regulations in 6 fields

12 interviews conducted:



- **Inspection authorities** (national or regional)
- **Operators**



1 BENCHMARKING: LESSONS LEARNT

- **Simplicity:** to facilitate the use of an SMS and the updates of procedures
- The very nature of the SMS implies that it will progressively gain in **maturity** (continuous improvement)
 - the experimental SMS will be gradually enhanced

Standard SMS Manuel? possible basis for work but **essential to adapt it to the context of each operator**

- **The SMS must be of benefit to the operator**, and must not hinder activity: efforts must focus on the contents and not the format

1 BENCHMARKING: LESSONS LEARNT

Importance of:

- The commitment of the « **chief executive** » who **defines the safety policy**
- Reflections on the **organisation** to be set up, **adapted to the size and issues of the entity**
- **the SMS « manager »** who coordinates and implements the SMS
- links with **quality procedures**
- collaboration with the **safety officer** for tunnels on the Trans-European network (length>500 m)

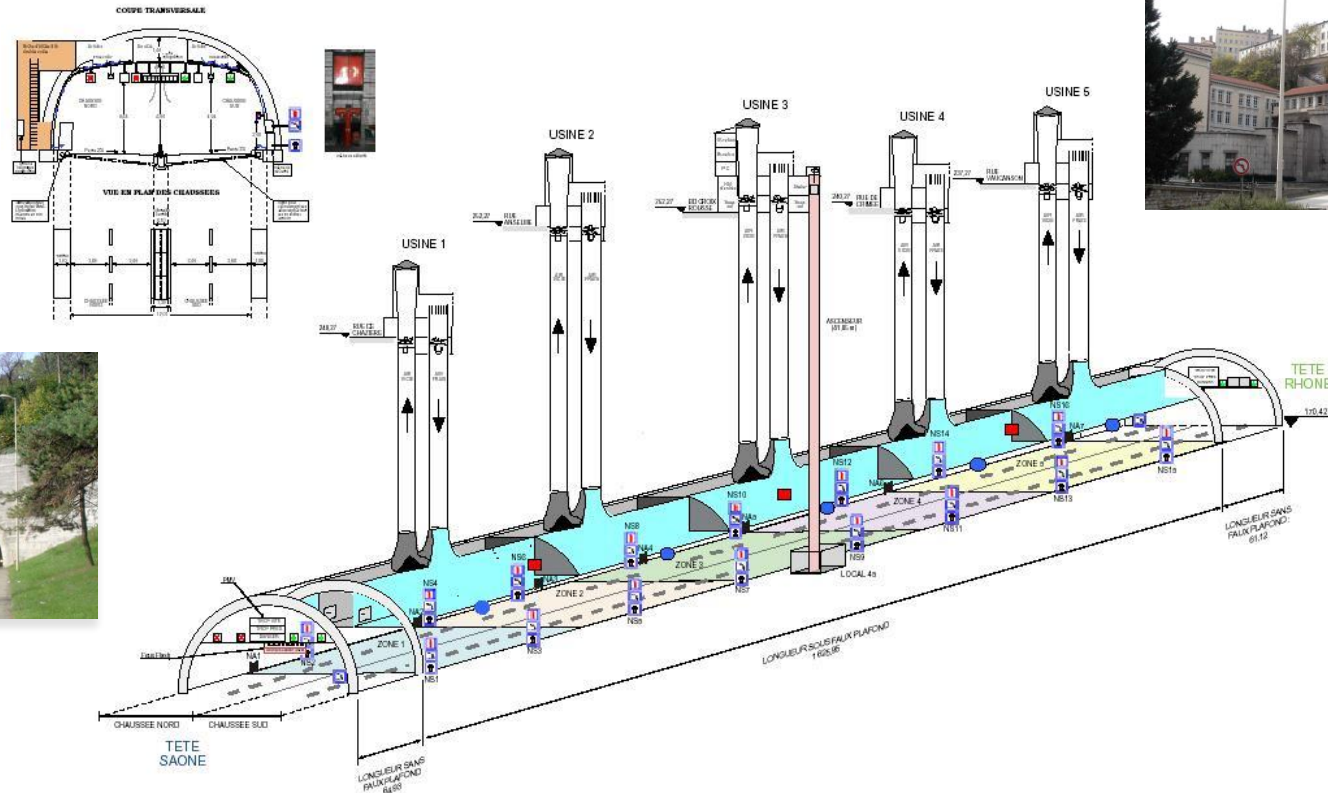
2 - Sustainable operation

- First steps towards sustainable operation of road tunnels - George Mavroyeni - Member of PIARC TC D.5 - Australia
- Refurbishment of the Louis-Hippolyte-La Fontaine tunnel - Alexandre Debs - Member of PIARC TC D.5 - Quebec, Canada
- **Croix Rousse tunnel - “Innovative use of a safety gallery for environmentally friendly modes of traffic” – Mathieu Hermen - La Métropole de Lyon.**



2 – The old Croix Rouse tunnel

- Opened in 1952.
- 1,752 metres long.
- Traffic (prior to works): 45,000 vehicles / day.



2 –The current tunnel

- One tube for road traffic
- An escape gallery (open to environmentally-friendly modes).



Rhône portal.



Saône portal.

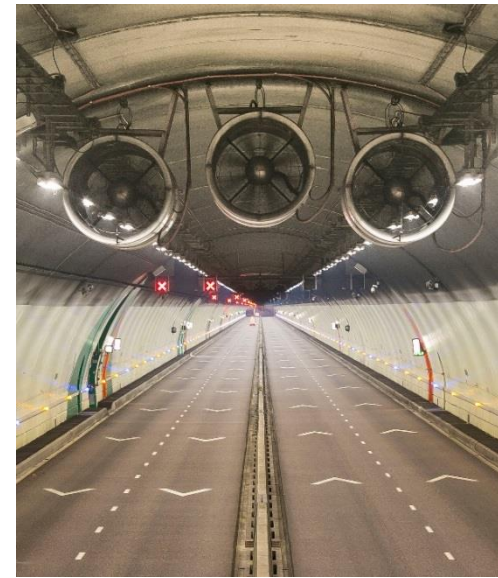
2 – The road traffic tube



New road traffic tube, two lanes each direction, with a central crash barrier



Emergency exit signage.



Jet fans.

2 –Escape gallery for environmentally-friendly modes



Overhead strip lighting



Jet fans



Video projectors



Escape gallery gate

2 –Daily figures

Vehicles: 47,000 vehicles /day

Cycles: 2,500 cycles / day.

- Peak of 3,500 passages per day in summer

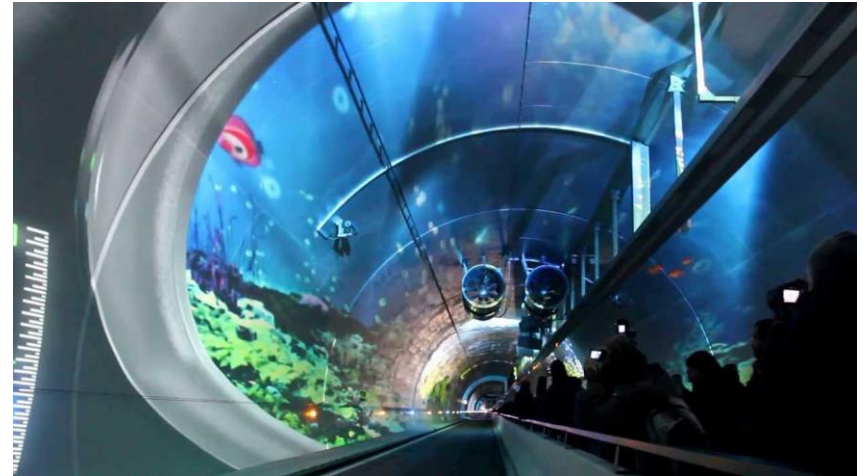
Pedestrians: 280 pedestrians/ day

- Peak of 500 passages on Sundays



Cycle counting station

2 - Light shows on the ceiling and side walls



2 – Use for festive events



Biennial food festival: a large number of visitors to manage



But also a cartoon show, a marathon, and a cycle race...

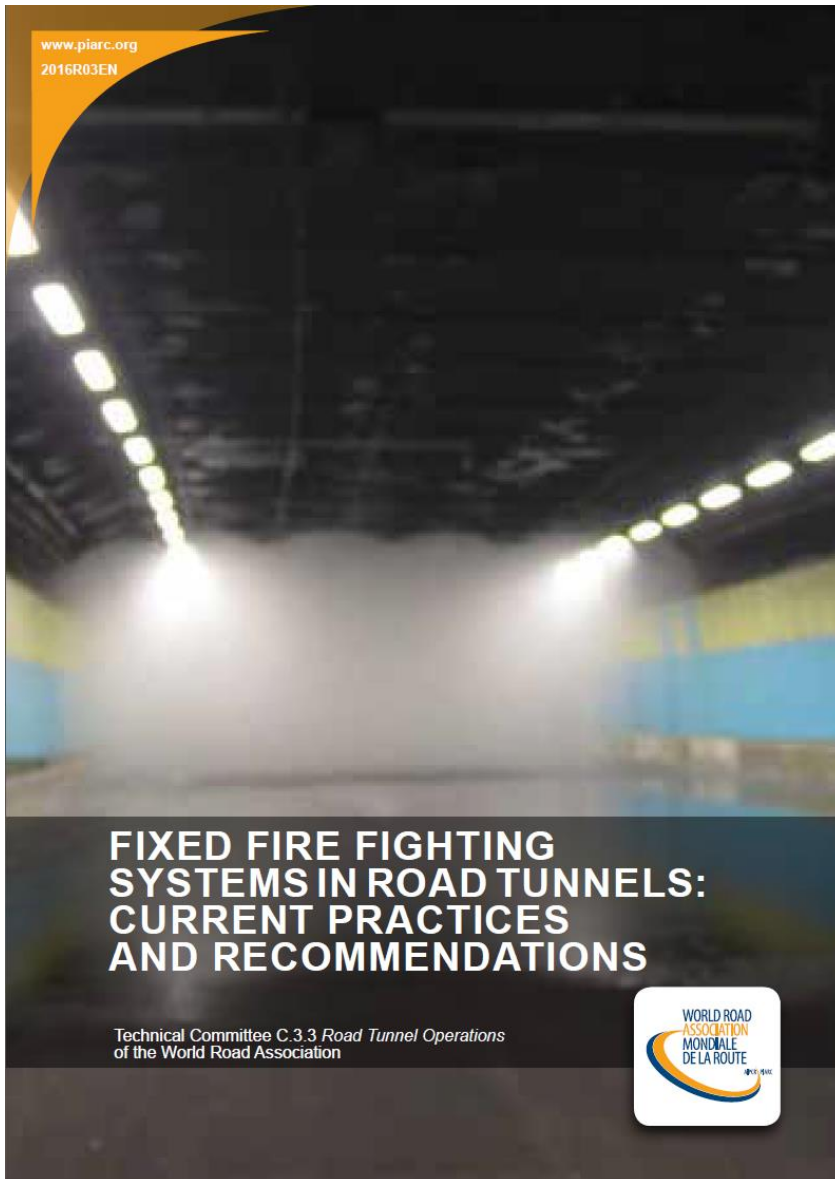
3 - Safety systems and equipment

- Centralised technical management system for expressway tunnels - Nam Goo KIM - PIARC TC D.5 member - South Korea
- **PIARC report on fixed fire-fighting systems in road tunnels: Current practices and recommendations - Les Fielding - ITA-COSUF Member - Former PIARC WG leader - UK**
- The use of public address systems to improve tunnel safety: current practices – Lim Hock Tay - PIARC TC D.5 member - Singapore



3 - FFFS in road tunnels

1. Introduction
2. Previous Work
3. Decision Factors.
4. Design Considerations
5. System Definition / Procurement.
6. Research and analysis of FFFS.
7. Conclusions and recommendations
8. Bibliography
9. Appendices



The FFFS report is available for free download from <http://www.piarc.org>
Search in Knowledge Base - Road Tunnel Operations

3 - FFFS in road tunnels

Purpose

- Replaces existing 2008 PIARC Guidelines

Scope

- provide strategic guidance and advice on FFFS to allow their implementation to be considered in a balanced manner

Target Audience

- Administrative Authorities, Tunnel Operators, Designers and Emergency Services

3 - FFFS in road tunnels

This report provides the current PIARC perspective on FFFS in road tunnels updating the previously stated positions in:

- 1999 - Fire and Smoke Control in Tunnel
- 2007 - Systems and Equipment for Fire and Smoke Control in Road Tunnels
- 2008 - Road Tunnels: An Assessment of Fixed Fire Fighting Systems



3 - FFFS : Conclusions and Recommendations

Design, operational management and maintenance

Where FFFS are installed, it is essential that they are correctly designed, installed, and integrated into the tunnel system, as well as properly tested, commissioned, maintained, and operated.

Speed of operation

FFFS can be activated in the very early stages of fire development even before fire-fighting activities commence by trained fire fighters.

Effective procedures

FFFS should only be activated after confirming the fire location and with the incident vehicle stopped. Clear plans and procedures are necessary for tunnel operators to activate the FFFS, or effective automatically operated systems implemented.

4 - Future safety challenges

- Alternative fuels and the future of road tunnels and road tunnel design - Gary Clark - PIARC WG 4 on Vehicle emissions - UK
- Training with virtual reality for tunnel safety (Romano Borchiellini - PIARC TC D.5 member - Italy
- **Using ITS for safety improvements in road tunnels - Henric Modig - Leader of PIARC WG3 on Human factors and ITS – Sweden.**



4 - Using ITS for safety improvements

Driving conditions

- Normal, pre-crash and post-crash

General challenges

- Restricted geometry
- Propagation issues of wireless signals
- Loss of satellites
- Electrical vehicles
- Emergency response



4 - Using ITS for safety improvements

Issues related to self-driving vehicles in tunnels

- Road markings
- Lighting conditions
- Emergency response process
- Fire and smoke detection and recognition

Other issues

- Platooning
- Data
- Mix of vehicles



4 - Using ITS for safety improvements

C-ITS opportunities

- Vehicle to vehicle communication V2V
 - Safe distance with heavy goods vehicles
 - Notification of dangerous goods vehicles
- Vehicle to infrastructure communication V2I
 - Notification of road, traffic and vehicle conditions
 - Dissemination of tunnel topology, e.g., exit location
 - Vehicle coordination through control centers
 - Road works, incident ahead and other hazards



4 - Using ITS for safety improvements

Other opportunities

- Persons with reduced mobility
 - Notification of type of impairment
 - Location
 - Service request
- Evacuation management
- Incident management
- Dynamically assigned lanes



Key conclusions and recommendations

(see programme of the next PIARC cycle:
1st thoughts proposed by the tunnel Committee)



Priority topics

Intelligent Transportation Systems:

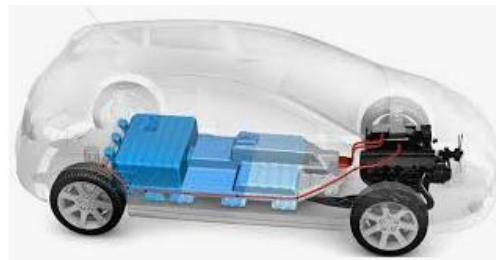
- Considerable technological advances in this field
- In a road tunnel environment, these systems can have a significant impact on operation and user safety
- Objective: to focus on the impacts of such systems on road tunnel operations and safety



Priority topics

New propulsion technologies (NPT):

- considerable headway has been made in this field
- road tunnel context: potentially **significant impact on user safety**
- objective: to focus on the **impacts of NPT** on road tunnel operations and safety.
- technologies include: hydrogen, liquefied natural gas (LNG), compressed natural gas (CNG), biodiesel, ethanol and electric vehicles.



Specific topics (continuous work)

- Large underground and interconnected infrastructures
- «Updates and improvements of the **web-based Road Tunnels Manual**»
- **New specific issues** which should be introduced in the Strategic Plan (in addition to ITS & New Propulsion Technologies ...):
 - Risk reduction measures and associated risk analysis methods
 - How should maintenance be managed in urban or heavy traffic tunnels?



How to become a PIARC member ?

- <https://www.piarc.org/en/membership/become-member/>
- **Contact Technical Committee road tunnel operations:
marc.tesson@developpement-durable.gouv.fr**

Thank you for your attention

Questions ?



Presentations, summary of proceedings, photos & video available on the conference web site :

<https://www.tunnel-conference-lyon.com/en/>