

# Tunnel Fire and Life Safety within the World Road Association (PIARC)

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**ABSTRACT:** This paper presents the global activities of the World Road Association (PIARC) in the area of fire and life safety in road tunnels. It traces the organisational structure in the form of technical committees, its publications, current activities and concludes with a summary as to the position of the organisation with regard to fire and life safety in tunnels.

## 1 INTRODUCTION

Organisation:

The World Road Association (PIARC) is organised into a series of technical committees.

The committee most concerned with Fire Life Safety in Road Tunnels is Technical Committee C-5 "Road Tunnel Operation".

Within the C-5 Technical Committee there are six active working groups (WG) as follows:

- WG1 Operations
- WG2 Pollution, ventilation, environment
- WG3 Human factors of safety
- WG4 Communications systems and safety
- WG5 Dangerous goods
- WG6 Fire and smoke control

## 2 PUBLICATIONS

There are a number of publications that publish the results of the work performed by the PIARC technical committees and working groups and are utilised to "get the message out" to both the public and colleagues. They include the magazine *Route/Roads*, Congress Reports that are published in conjunction with each World Road Congress held every three years and Inter Congress Reports that are specialty reports published between tri-annual World Road Congresses.

## 3 WORKING GROUP ACTIVITIES

Each of the technical committees and working groups has a published work plan for each of the three-year cycles between World Congresses. A major portion of the fire and life safety work within

Technical Committee C-5 is handled by Working Group 6, "Fire and Smoke Control". Each of the working groups, however, does work in a cooperative way to coordinate any issues relating to fire and life safety as shown in the paragraphs below.

**Working Group 1 Operation** is currently developing a Best Practice Manual for road tunnel operation that will include a chapter addressing Safety. This chapter will include issues relating to fire-life safety.

**Working Group 2 Pollution, Ventilation, Environment** is studying the requirements for jet fans, longitudinal flow for smoke control, emergency ventilation control and smoke dampers all as related to fire life safety.

**Working Group 3 Human Factors of Safety** is studying the human factors of safety including the means by which such behavior may be modified.

**Working Group 4 Communications Systems and Safety** is studying the requirements of lay-bys, emergency recesses and emergency exits,

**Working Group 5 Dangerous Goods** completed, as part of a joint OECD/PIARC effort, development of a new set of risk assessment and management software to allow transport operators to evaluate the transport of dangerous goods.

**Working Group 6 Fire and Smoke Control** has underway eight specific work tasks relating to road tunnel fire and life safety. These work tasks are:

- Lessons from past disasters
- Safety concept for tunnel fires

- Structural resistance to fire
- Transverse ventilation
- Emergency exits
- Fire specific safety equipment
- Fire response management
- Emergency ventilation system operation

Each of these tasks is detailed in the paragraphs below:

**Lessons from past disasters** will include both a database of tunnel fires and an analysis of the recent disastrous fires in road tunnels including the incidents in the Mont Blanc, Tauern and Gotthard Tunnels. This analysis will incorporate a detailed description of the tunnel involved and comparisons of traffic, ventilation, safety facilities, tunnel operation, fire management (by the operators, responders and rescuers), user behavior and the tunnel environment during the fire.

The completed analysis will be documented in a published article in *Routes/Roads* in 2002 and a short PIARC report in 2003.

**Safety concept for tunnel fires** will include defining objectives for the development of design fire scenarios including the development of the fire.

An initial draft of this work was presented to PIARC C5 Working Group 6 in Helsinki.

The results of this work will be published in the PIARC Congress Report in 2003.

**Structures resistance to fire** includes the recommendation of appropriate temperature/time curves to be applied in the evaluation of the ability of a structure to withstand a fire in an associated tunnel along with quantified objectives for both safety and risk of traffic disruption.

This work is being done in co-operation with ITA Working Group 6 on the basis that PIARC defines the objectives (temperature-time curves and resistance times) and ITA examines the materials and construction methods to meet these objectives.

The planned output of this work is a joint PIARC-ITA publication in 2002-2003 along with articles to be published in publications such as *Route/Roads*, *Tunnelling and Underground Space Technology and Tunnels*.

**Transverse ventilation** includes a definition of the design and operational aspects of transverse ventila-

tion systems during fire based emergencies and will include a discussion on smoke de-stratification during emergency operation. It will also include a discussion of automatic operation of a transverse ventilation system.

A first draft of this work was distributed to the working group in Helsinki.

The results of this work effort will be published either in a *Routes/Roads* article or in a short PIARC Report in 2002-2003

**Emergency exits** will include an evaluation of the kinds and characteristics of emergency exits will address the necessary spacing between exits according to human behavior tendencies and tunnel ventilation. This task will include escape modeling.

A data survey has been conducted and preliminary results presented to PIARC C-5 Working Group 6 at their meeting in Helsinki.

This work will be done in cooperation with PIARC C-5 Working Group 3 "Human Factors of Safety" who will provide the required data on people behavior (especially detection and reaction time in case of a fire and escape speed).

This work effort will result in a short PIARC Report in 2002/2003.

**Fire specific safety equipment** will include the evaluation and possible full-scale testing of fire specific equipment such as sprinklers, water mists and other automatic fire suppression systems for application in road tunnels. Automatic fire detection equipment will also be examined as a part of this work.

Results of an initial survey were presented to PIARC C-5 Working Group 6 in Helsinki.

The output from this work effort will be published in a PIARC "State-of the Art" Report as new information.

**Fire response management** will include an organization of fire tests for tunnel commissioning and for staff training and will incorporate the definition of the anticipated behavior expected from users in the event of a fire in the tunnel.

This work will be done in cooperation with PIARC C-5 Working Group 3 "Human Factors of Safety"

**Emergency ventilation system operation/control** will include a discussion the operation control procedures to be incorporated in the design and con-

struction of all tunnel ventilation systems for ultimate use in a fire-based emergency.

#### 4 SUMMARY

The safety issues confronting PIARC, its working groups and the road tunnel industry in the pursuit of safe tunnels in the event of the occurrence of a fire are:

**Systems** - The systems must be properly configured and suitable for operation in the hostile environment of a tunnel fire.

**Operation** - Tunnel operators must be able to respond appropriately and timely to all aspects of a fire-based emergency.

**PTE** - There must be proper Planning, Training (including retraining) and Exercises

**Communications** - There must be adequate communications between all responders during an emergency.

**Human Behavior** - There must be a better understanding of human behavior during emergencies and of how to better enlighten the public on proper behavior in tunnel emergencies.

**Facilities/Equipment** - The tunnel facilities and equipment must be capable of sustained operation in the environment created by a fire within the tunnel.

**Testing** - Testing must be continued to learn more about the actual behavior of fire and smoke in a tunnel and to provide significant guidance to tunnel fire responders.

**Learn** - We must learn from experience, particularly from actual incidents and tests.

**Overall Safety** - How safe should we make the tunnels of tomorrow?

**New Technology** - We must continue to examine new technology for application to road tunnels. This new technology can be relative to new systems or equipment or new analytical or design techniques.

**ALL OF THE ELEMENTS LISTED ABOVE MUST BE ADDRESSED AND A BALANCE ACHIEVED TO ASSURE SAFE OPERATION OF ANY ROAD TUNNEL.**