# Assessment of Fixed Fire Fighting Systems

**Art Bendelius**

➔A & G Consultants, Inc.
- Associated Consultant
  - Parsons Brinckerhoff

# Presentation

- Introduction
- System Types
- Previous PIARC Position
- Detection
- Applications & Testing
- Current PIARC Position
- Conclusions
- Related Publications

## Introduction

# Present the results of the efforts of TC3.3 - Working Group 6 on the assessment of fixed fire fighting systems in road tunnels

## Fire Suppression Purpose

**Provide the necessary facilities and equipment to permit suppression of the fire within a reasonable time frame**

## Fire Suppression Systems

- **Fire Extinguishers**
- **Water Supply Standpipe**
  - Hydrants
  - Hose Valves
  - Hose
- **Fixed Fire Fighting Systems (FFFS)**
- **Drainage**

# Fixed Fire Fighting Systems (FFFS)

## ➔ Water based systems

- Sprinkler system
- Deluge system
- Water mist system
- Additive agents

## ➔ Other systems

- Smoke curtain
- Gas systems

## Glossary Definitions

# Sprinkler system

- A system designed to be operated by the fire itself so as to dispense water in the areas where it is needed to ensure rapid suppression of the fire. Sprinklers are activated automatically nozzle by nozzle.

# Deluge system

- An open system activated on a zone-by-zone basis. Operation can be automatic or manual.

# Water mist system

- A system that operates by propelling very small droplets of water.

# System Categories

## There are two categories of systems

- **Systems fixed in the tunnel**
- Systems fixed on vehicles
  - in passenger compartment
  - in engine compartment
  - in load bay of HGV

## Previous PIARC Position

# Initial discussions

- World Road Congresses
  - 1983 Sydney, Australia
  - 1999 Kuala Lumpur, Malaysia

# Some of the concerns expressed

- Fires often start in engine compartment or in load bay
- Flammable gases are produced and may cause explosion
- Smoke layer is de-stratified
- Visibility is reduced
- Maintenance can be costly

## PIARC Position in 1999

**"… sprinklers (FFFS) are generally not considered as cost-effective and are not recommended in usual road tunnels."**

**However, it was also noted that:**

- Sprinklers can be used to cool down vehicles to stop the fire spreading to other vehicles.
- If sprinklers/deluge systems are installed, they must not be activated before all occupants have evacuated.

## Impact on PIARC Position

**In the past the PIARC position regarding the use of FFFS tended to be negative. This created extensive discussions over the years.**

**During the past years research and testing work on FFFS has been accomplished. The concerns expressed by PIARC have now been studied in greater detail.**

**These results provide a better insight into the pros and cons of FFFS as a basis for a making a more educated judgment.**

## Fire Detection

- **The installation of a FFFS in a road tunnel mandates that it be installed with an effective and efficient fire detection and location system.**
- **Fires must be detected in road tunnels as early and as accurately as possible to permit timely response by operating agency and emergency response personnel.**

## Applications

**Several countries have or are now considering the installation of FFFS in road tunnels.**

| | |
|---|---|
| ➔ Australia | numerous installed – 20 years |
| ➔ Austria | two installed |
| ➔ Japan | numerous installed – 40 years |
| ➔ The Netherlands | one rail tunnel installed |
| ➔ Spain | one planned |
| ➔ United States | five installed – 40 years |

**A number of countries, such as France , the Netherlands, Norway and Spain, have recently conducted tests on the installation of FFFS in tunnels.**

# Systems should be tested

- ➔ under conditions as realistic as possible
- ➔ to avoid investments in novel systems that might not succeed
- ➔ as part of internationally coordinated research programmes
  - not be tested on a national basis
  - global cooperation

## Current PIARC Current Position

**The latest discussions within Working Group 6 “Ventilation and Fire Control” of PIARC Technical Committee C3.3 “Tunnel Operation” led to the following opinion:**

- ➔ It is not possible given the present status of knowledge to establish general rules relating to the decision to install FFFS in tunnels or not. For a given tunnel a specific risk analysis regarding the appropriateness of FFFS must be conducted.

# Current PIARC Position

**The risk analysis of a tunnel facility considering a FFFS should include consideration of:**

- Safety of the users
- Capacity / capabilities of rescue services
- Resistance of structure against fire
- Balance between costs and benefits of FFFS
- Interaction between various safety systems

# Current PIARC Position

**There are three extremely important requirements that must be met:**

- The installation of a FFFS must be combined with the installation of an appropriate fire detection system.
- Special attention must be paid to the maintenance and operating costs of the system.
- During the whole life cycle of the tunnel these costs as well as the full capacity and function of the FFFS must be guaranteed.

## Current PIARC position

# Advantages

- Reduce chance of fire spreading to other vehicles
- Improved accessibility to fire seat
- Improved protection of structure

# Disadvantages

- De-stratification of smoke layer
- More complex equipment
  - Increased maintenance
- Potential visibility reduction

# Basic Requirements of FFFS

- Must be functional at all times
- Must be reliable under all conditions of tunnel environment
- Must have acceptable investment cost
- Must have low maintenance cost
- Must be easy to install and to use

# Conclusions

A risk analysis must be conducted before the decision is made to install a FFFS.

The installation of a FFFS requires that it be coupled with an appropriate and reliable fire detection and location system.

When a FFFS is installed in a given tunnel, a firm commitment must be made to guarantee the proper level of maintenance and operating costs for the FFFS.

Continuing research is required to answer the remaining questions.

## Several Remaining Questions

**1. What is the correct timing to initiate the operation of a FFFS?**

**2. Is there any offsetting compensation in conjunction with the installation of a FFFS?**

- ➔ Such as reduction of other safety systems such as ventilation

**3. What is the mutual impact on the components and operation of other safety systems?**

# New Publication

## Road Tunnels: An Assessment Of Fixed Fire Fighting Systems


**PIARC - World Road Association**

# Road Tunnels: An Assessment of FFFS

## NFPA Position

# 2004 Edition

- "… the use of sprinklers (FFFS) in road tunnels generally is not recommended."

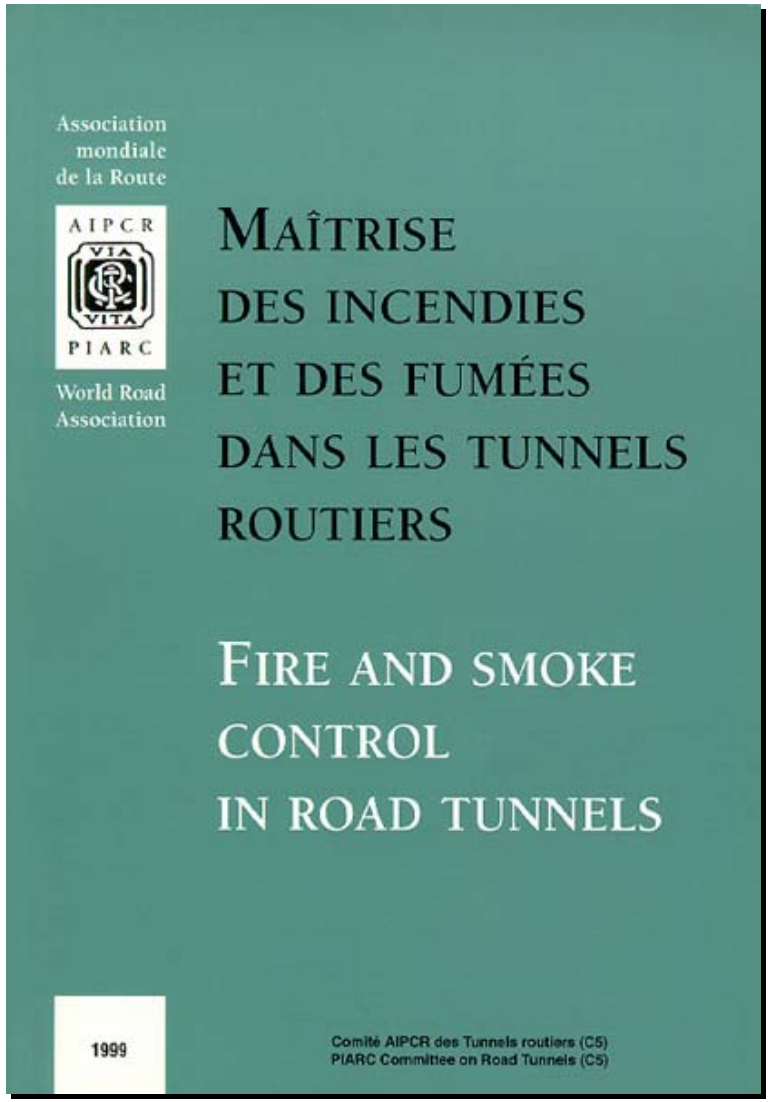
# 2008 Edition

- "Where it can be shown by engineering analysis that the level of safety can be equal or exceeded by the use of fixed fire fighting systems as part of an integrated approach to the management of safety, such systems shall be permitted …"

## Related Publication

# FIRE AND SMOKE CONTROL IN ROAD TUNNELS

**1999** initial printing
**2004** second printing



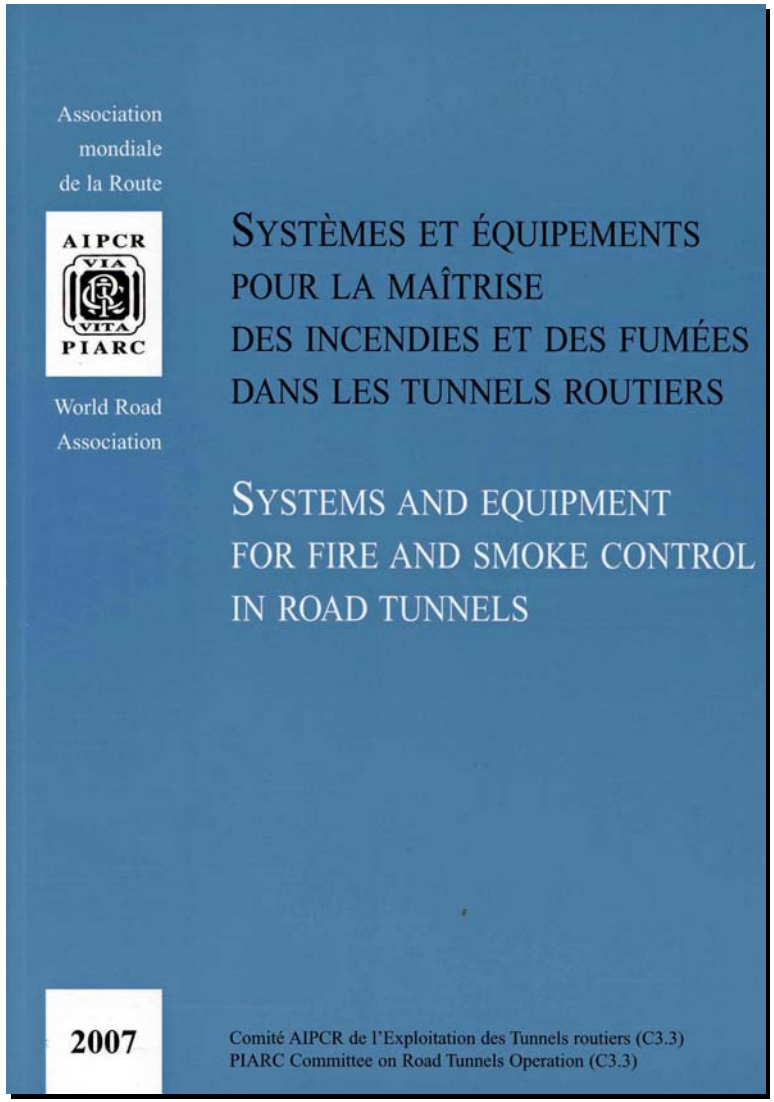

**PIARC**
**World Road Association**

# Fire and Smoke Control in Road Tunnels

# SYSTEMS AND EQUIPMENT FOR FIRE AND SMOKE CONTROL IN ROAD TUNNELS

## 2007

**PIARC**
**World Road Association**



# Systems & Equipment for Fire & Smoke Control

# Thank you
# for your
# kind attention