EUROPEAN FIRE SPRINKLER NETWORK

**A European Fire Safety Coalition**

# Comments on the Proposal for a Directive of the European Parliament and of the Council on the minimum safety requirements for tunnels in the Trans-European Road Network - Inter-institutional File 2002/0309 (COD)

September 2003

70 Upper Richmond Road
London SW15 2RP
UNITED KINGDOM
Telephone: +44 20 8877 2600 – Fax: +44 20 8877 2642

## Executive Summary

This report has been written by the European Fire Sprinkler Network as a pro-active contribution to the development of the Directive on tunnel fire safety, 2002/0309 (COD). The European Fire Sprinkler Network is a not-for-profit organisation that brings together many different strands of the fire safety community, all with a common aim to improve fire safety in Europe through the wider use of fire sprinkler and other water-based fire suppression systems.

As yet the Directive does not mention fire suppression systems. This report considers the significant contribution to road tunnel fire safety that can be made by the fitting of fire suppression systems. It discusses the possible reasons for the omission of fire suppression systems from the draft Directive and counters the myths and misconceptions around fire suppression systems in tunnels.

Many fire safety experts, including fire services, fire research institutes, insurers and fire protection associations, believe that fire suppression systems should be fitted in the busiest and most vulnerable tunnels. Fire suppression systems will:

- slow the development of the fire
- reduce the evolution of heat and smoke
- cool the surrounding area

These actions will ease escape for those trapped in the tunnel. They will also assist the fire services to approach the fire before it becomes too large and too hot for them to get near it. The fire will be quickly extinguished and damage kept to a minimum. While the measures currently in the draft Directive will generally improve fire safety, fire safety experts are still concerned that some important tunnels will remain vulnerable to a serious fire with the potential for multiple deaths and extended tunnel closure.

Australia and Japan have fitted fire suppression systems in key tunnels for decades with positive experience in real fires. There are also several research reports of fire tests that demonstrate the theoretical benefits of fire suppression systems in tunnels. Following a brief summary of this experience this report concludes with some recommended modifications to the Minimum Equipment Table in the Annex to the Directive. Specifically it recommends fire suppression systems in tunnels with a traffic flow of more than 2000 vehicles/day/lane for bi-directional tunnels longer than 1000m and for single flow tunnels longer than 3000m. These recommendations are in line with the guidelines successfully applied in Japan.

The European Fire Sprinkler Network respectfully submits this report for consideration by those drafting the Directive in the belief that its recommendations offer a positive, cost-effective contribution to European road tunnel fire safety.

London
September 2003

## Introduction

This report offers the contribution of the European Fire Sprinkler Network to the proposed Directive on tunnel fire safety 2002/0309 (COD). It has been written to provide a pro-active input to the preparation of this Directive and in particular to highlight the major improvement to tunnel fire safety that can be made by active fire suppression systems.

Organised at a European level, the European Fire Sprinkler Network represents thousands of fire safety professionals from many European countries. It believes it is therefore well-qualified to make a contribution to the development of this Directive and on its members' behalf to summarise the views of a large part of Europe's fire safety community.

## Background

In recent years Europe has experienced a series of fires in tunnels with multiple loss of life. The most severe loss of life occurred in the Kaprun ski resort in Austria, where a fire in a heater on a mountain railway train spread through the train to kill all 155 people on board[1].

Besides loss of life these fires caused huge economic losses. Several road tunnels that are a key part of Europe's transport infrastructure were forced to close for long periods while they were refurbished[2]. Meanwhile traffic had to find alternative, much longer, slower and more expensive routes. It is this economic loss that has provided the European Commission with the legal basis to propose a Directive on road tunnel fire safety. Fire safety in other tunnels, such as the Kaprun ski resort tunnel, is not considered by the proposed Directive.

Most of those who died in the road tunnel fires were not involved in the cause of the fire but died attempting to escape it. Although loss of life is not the legal basis for Community action on tunnel fire safety, the European Fire Sprinkler Network notes this has been considered in the proposed Directive, "Safety measures shall provide the ideal prerequisites for enabling people involved in the incident to rescue themselves" and "This Directive aims at ensuring a minimum level of safety for road users in tunnels".

The European Fire Sprinkler Network supports the Directive and believes that in addition to economic losses it is right to consider the safety of those trapped in a tunnel by a fire, as well as the safety of fire fighters who attempt to extinguish a fire.

The current draft Directive is made up of Articles, which set out how the Directive would operate and an Annex with specific measures including a table of "Minimum Equipment". The European Fire Sprinkler Network will comment on this Annex, specifically the latest draft resulting from the Expert Meeting on 26 May 2003.

---

[1] Kaprun, Austria, 11 November 2000.
[2] Mont Blanc 3 years; Eurotunnel 6 months; Tauern 3 months; St. Gotthard 2 months.

**Fire Suppression Systems Omitted**

The Annex considers all aspects of tunnel fire safety and prescribes specific measures to improve each of these fire safety aspects. However, it neglects to make use of the single most effective tool to assist escape and fire fighter access: fire suppression systems. This omission was highlighted in a letter from the European Federation of Public Service Unions to Reinhard Rack, MEP[3], the European Parliament Rapporteur on this Co-Decision Directive, in which was stated,

"That no fire safety measure should be discounted" and

"That any tunnel which falls within the scope of the Directive is provided with such measures and equipment as are considered necessary in the light of the risk analysis to ensure that the effects of the fire can be contained, controlled and suppressed with a degree of certainty until such time that the fire can be dealt with by the fire fighting services.

"That any tunnel which falls within the scope of the Directive will be provided with such measures and equipment as are considered necessary in the light of the risk analysis that will enable the fire fighting and rescue services to gain easy access to the tunnel and approach a fire in relative safety and deal with it safely."

The letter also notes that tunnel operators should not assume people will quickly abandon their cars to evacuate a tunnel. This view is supported by recent research from The Netherlands[4]. Furthermore it cannot be assumed that the public will use portable extinguishers to fight incipient fires.

If a fire is suppressed, the production of heat and smoke is reduced so that people can escape more easily and fire fighters can access the fire more easily. In Japan the longest and busiest tunnels are fitted with zoned deluge fire sprinkler systems to control the fire so that fire services can approach it[5]. A similar approach is taken in Australia. These systems are either manually or automatically released to spray water over a section of the tunnel, typically 50m, large enough to cover the area of an incipient fire. The aim of the systems is to cool the fire and slow its development.

It is also the view of the European Fire Sprinkler Network, German vfdb[6], VdS[7] and bvfa[8], British CACFOA[9], Swiss ETHZ[10], Australian AFAC[11] and many other fire safety expert organisations that one of the key tools to ensure fire safety in a tunnel is an active fire suppression system. If left to develop, a fire in a tunnel can grow

---

[3] Letter of 11 April 2003 from Jan Willem Goudriaan, EPSU Deputy General Secretary
[4] Dr L.C. Boer, TNO, Tunnelflits July 2003
[5] H. Mashimo, Public Works Research Institute, Conference 2001; Sprinklers in Japanese Road Tunnels, report by Chiyoda Engineering Consultants Co., Ltd. for Ministry of Transport, The Netherlands, December 2001
[6] Vereinigung zur Förderung des Deutschen Brandschutzes e.V. (Association for the promotion of German fire safety) www.vfdb.de This organisation has many fire service members.
[7] Verband der Schadenversicherer (Association of Loss Insurers) www.vds.de
[8] Bundesverband Feuerlöschgeräte und -anlagen e.V. www.bvfa.de
[9] Chief and Assistant Chief Fire Officers' Association www.fire-uk.org
[10] Werner Zeberli, Swiss Federal Institute of Technology, CTIF Conference 8 November 2002
[11] Fire Safety Guidelines for Road Tunnels 10/09/01, Australian Fire Authorities Council

rapidly, generating enormous heat and volumes of smoke. Fire fighters attempting to enter the tunnel are unable to get close enough to the fire to begin to tackle it. As an example of this problem, in the Mont Blanc tunnel a fire tender 400m from the fire centre was ignited by radiant heat.

A fire suppression system will:

- quickly cool the tunnel around the fire
- reduce the size of the fire
- slow the production of heat and smoke

In some cases the fire suppression system will extinguish the fire; in all cases it will make escape for those trapped in the tunnel less hazardous and facilitate access to the fire by the fire services. Lives will be saved, the fire will be fully extinguished more rapidly and damage to the tunnel will be reduced.

**Possible Reasons for Omission of Active Fire Suppression Systems**

Although many experts agree that active fire suppression systems offer a major benefit to tunnel fire safety, this technology has not been included in the measures specified in the Directive. This report will now attempt to identify the possible reasons for this omission and reassure the reader on each point.

*Cost*

Authorities may be concerned that fire suppression systems are expensive. Estimates from the German VdS and from a recent quotation for the Stone Henge Tunnel in the U.K. agree that tunnel fire suppression systems can be priced at about €1 million per kilometre. This cost is modest compared to the €400 million to repair the Mont Blanc Tunnel and the further economic loss resulting from its closure. A fire suppression system gives the best chance for people to escape and for fire fighters to combat the fire early and limit damage. Key tunnels, whose closure would cause significant traffic issues and economic loss, should be considered for fire suppression systems.

*Disruption*

Fire suppression systems can be fitted in the roof of existing tunnels outside peak traffic hours and need not require lengthy tunnel closure.

*Performance*

Fire suppression systems have been fitted in 8 road tunnels in Australia, 82 in Japan and in the Mount Baker Tunnel, Seattle, USA. Fire tests in Australia[12] showed that without a fire suppression system, radiant heat in enclosed spaces would cause fire to spread from one vehicle to another. With a suppression system:

- fire was suppressed and did not spread to other vehicles
- volume of smoke was greatly reduced
- toxicity of smoke was significantly reduced
- temperatures in structural members were kept below 100˚C

[12] Economical Car Parks - A Guide to Fire Safety BHP Steel Australia, I.D. Bennets, K.W. Poh, I.R. Thomas, March 1999.

Broadly similar conclusions were drawn from a series of fire tests performed in the Netherlands[13]. Some commentators have concluded that since a fire suppression system cannot extinguish a fire either inside a vehicle or shielded beneath it, the system does not afford a significant benefit. Extinguishment is not the aim of the system. The aim of the system is to suppress the fire, so that it does not develop and the surrounding area is cooled. Those trapped in the tunnel will then be able to escape to safety and the fire service will be able to get close to the fire and fully extinguish it.

Japan experiences 10 to 16 tunnel fires each year that require a response from the fire service. For 2 to 3 of these fires the deluge fire sprinkler system is released[14]. No failures have been reported. Suppression systems are also reported to have dealt with fires in tunnels in Australia but details are not available.

*Accidental Release*
It may be argued that a water-based fire suppression system could operate accidentally, surprise drivers and so cause a traffic accident. The first tunnel suppression system was fitted in Japan in 1958 in the Kaziwara-Tennosan Tunnel of the Meishin Expressway. Forty-five years of experience have shown that this concern is invalid and Japan continues to fit fire suppression systems in tunnels.

*Steam*
It has been suggested that water from an active fire suppression system could produce hot steam when released onto a fire and that this steam could harm those attempting to escape. Fire fighters do not report scalding as a result of their daily interventions with water. If water is the wrong agent for a system it is also wrong for fire fighters. In fact a water-based suppression system cools the fire. Experience with deluge fire sprinkler systems in tunnels in Japan has shown that this is not a valid concern.

*Explosion*
To those familiar with fire suppression systems this is a surprising concern. Water is inert to most materials and is even used to snuff out flare stacks in refineries. Water is widely accepted to be a safe extinguishing agent for use on vehicle fires by the fire services. The basis for this concern is thought to be a test performed in Switzerland in 1967 in which a suppression system extinguished a fire and was then turned off, before all hot surfaces were cooled. Vapours then found a hot surface and reignited[15]. Properly trained fire fighters know the importance of cooling hot surfaces before they turn off their hoses.

None of the reasons commonly cited to reject the use of fire suppression systems in tunnels is valid. Fire suppression systems are a cost-effective, reliable tool to reduce the risk of loss of life and damage to a tunnel in a fire. They should be part of the overall tunnel fire safety concept proposed in the Directive.

---

[13] Tests on Fire Detection Systems and Sprinkler in a Tunnel, Ir. J.W. Huijben, Bouwdienst Rijkswaterstaat Centre for Tunnel Safety, December 2002
[14] Sprinklers in Japanese Road Tunnels, report by Chiyoda Engineering Consultants Co., Ltd. for Ministry of Transport, The Netherlands, December 2001
[15] Werner Zeberli, Swiss Institute of Safety and Security, CTIF Conference, November 2002, Regensdorf, Switzerland

**Proposed Modifications to the Directive**

The primary aim of the Directive is to reduce economic loss resulting from an extended closure of a key road tunnel on the Trans-European Network. Therefore the busiest tunnels should have the highest level of fire safety so as to minimise the effects of a fire. The busiest tunnels may also be expected to be those most likely to suffer a fire. Fire suppression systems should be considered for the busiest tunnels that are also the most vulnerable to severe damage in a fire.

Bi-directional tunnels are more vulnerable to vehicle accidents than single flow tunnels. They are also more difficult to clear of smoke and more difficult for the fire and rescue services to access. These tunnels are in particular need of the security of fire suppression systems.

Very long single flow tunnels are difficult to access since it takes some time for the traffic to clear and for the rescue services to drive to the fire. Furthermore escape is likely to be slow, even assuming that all those in the tunnel are able to walk such a long distance. These tunnels should also be fitted with fire suppression systems.

Drawing from practice common in Japan and Australia, add:

**MINIMUM EQUIPMENT TABLE […]**

| Equipment Category | Equipment Type | Traffic Volume | Tunnel Length | Remarks |
|---|---|---|---|---|
| Fire Suppression | Water-based suppression systems | higher than 2000 veh/d/lane | For bi-directional tunnels longer than 1000 m | For single flow tunnels longer than 3000 m |

**The European Fire Sprinkler Network**

Set up in 2002, the European Fire Sprinkler Network www.eurosprinkler.org is a not-for-profit organisation open to membership by all those with an interest in improving fire safety through encouraging the fitting of fire sprinkler systems. The founding members were Eurofeu www.eurofeu.org, whose members include the national fire sprinkler installer trade associations in Europe, and the International Fire Sprinkler Association www.sprinklerworld.org, whose members include all the major manufacturers of fire sprinklers and related components.

Since its inception the main laboratories in Europe which certify fire protection products and systems in accordance with EN and insurance standards (BRE of the U.K., CNPP of France, SP of Sweden, TÜV of Germany and VdS of Germany) have joined the European Fire Sprinkler Network. Furthermore a number of consulting companies have joined. The Network also maintains links with fire services and insurance companies in many European countries.

The current membership is drawn from Belgium, Denmark, Finland, France, Germany, Italy, Spain, Sweden, Switzerland and the U.K. It represents thousands of fire safety professionals across Europe.