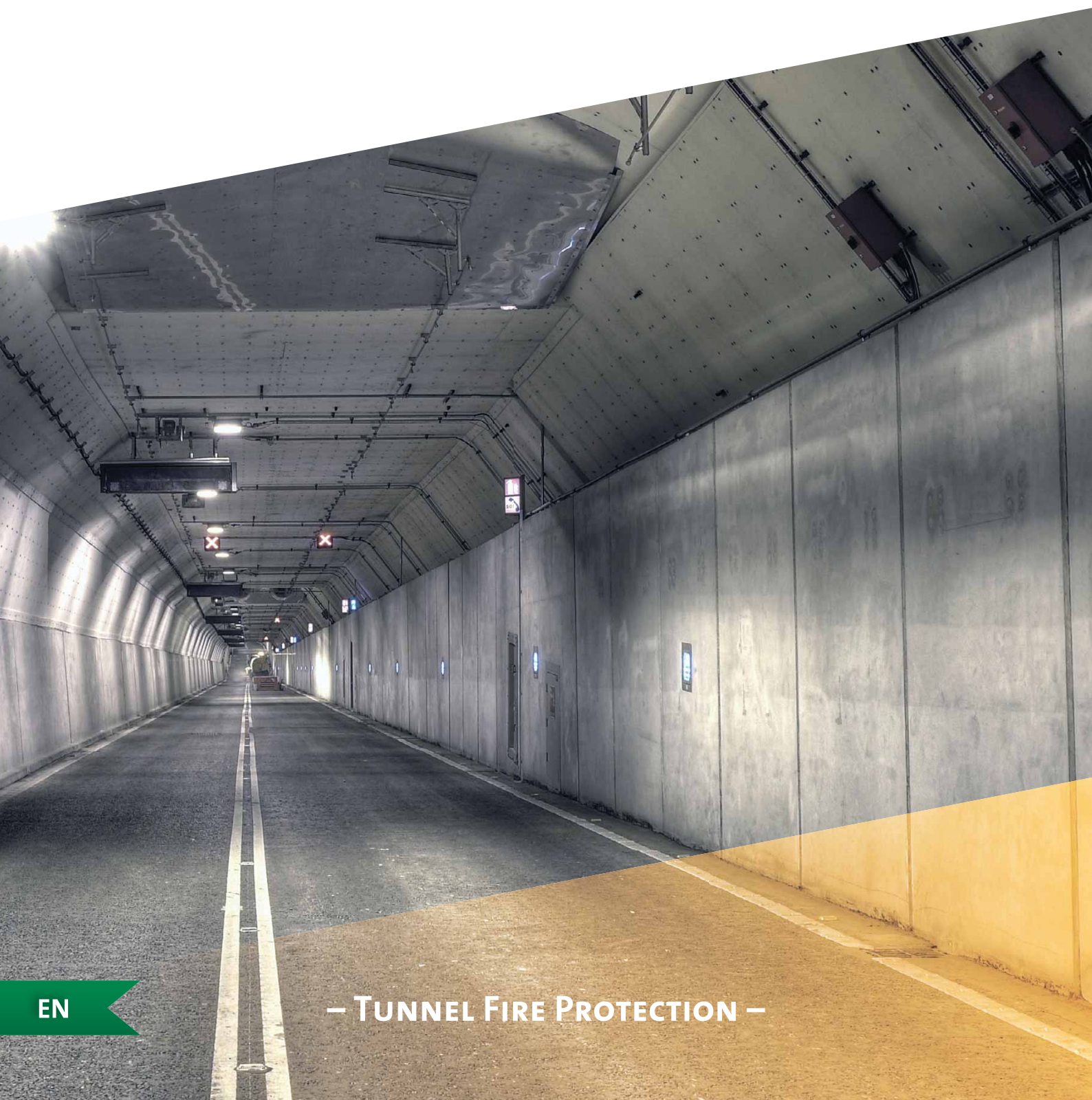


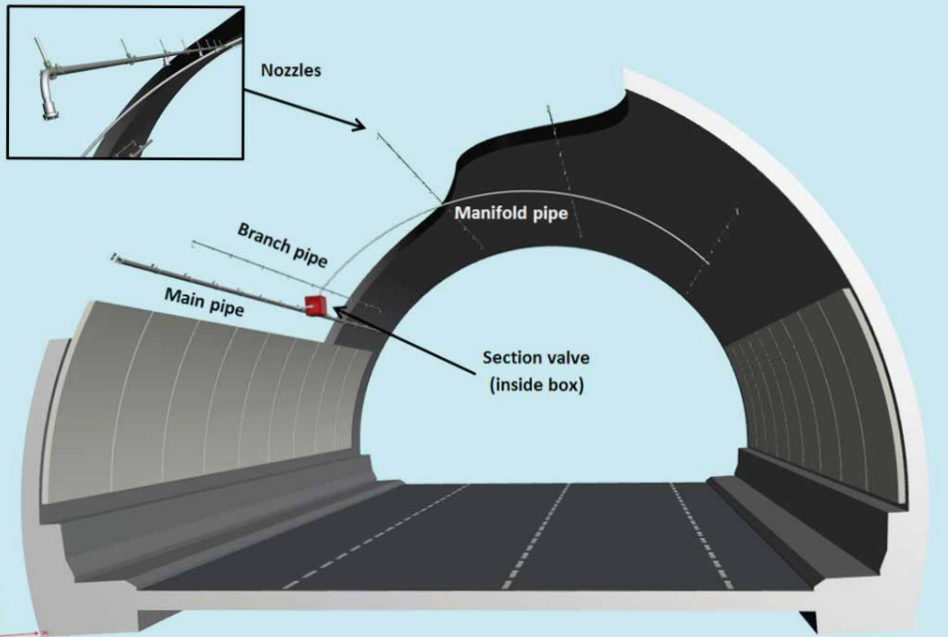


The Smarter Way of Fire Fighting



EN

— TUNNEL FIRE PROTECTION —



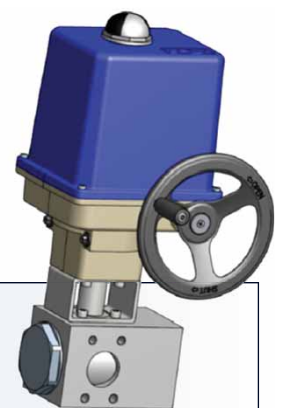
FOGTEC – Tunnel safety experts

FOGTEC is the worldwide leading company for Fixed Fire Fighting Systems (FFFS) in tunnels and underground facilities and offers a wide range of services for the clients:

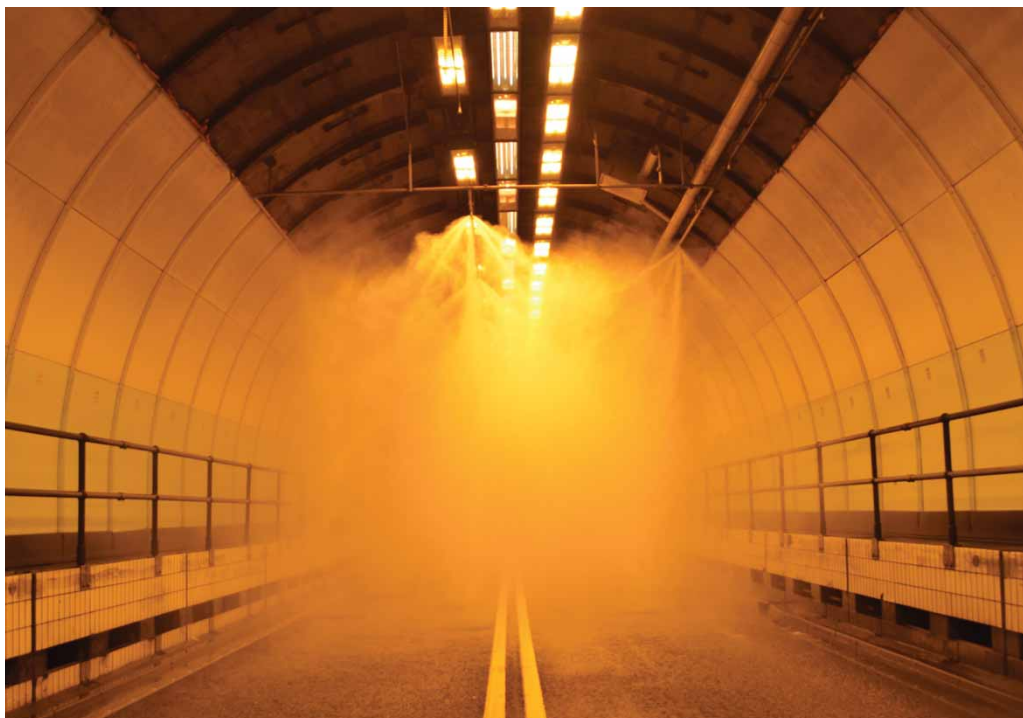
- ▶ Consulting & Risk analysis
- ▶ Development and design of FFFS
- ▶ Full Scale Fire Tests
- ▶ RAMS & LCC calculations
- ▶ Detection & control systems
- ▶ SIL certified control systems
- ▶ Training of fire brigades and operators
- ▶ Installation of FFFS
- ▶ Maintenance and operation
- ▶ Integration of FFFS into the overall tunnel safety concept

Low Life Cycle Costs

FOGTEC's patented section valves allow a regular remote testing without discharging water – ensuring a high system availability and low Life Cycle Costs.



Section valve with remote service function

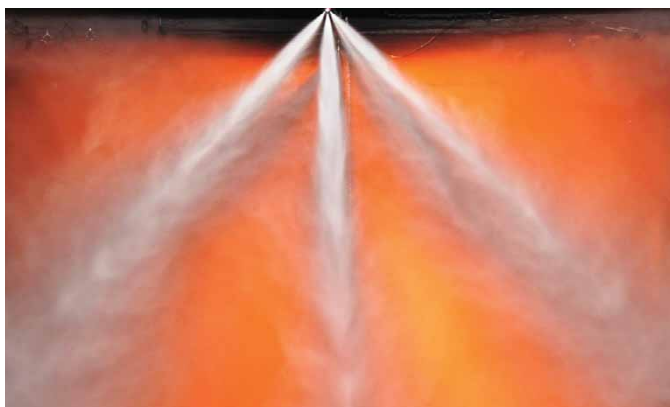


Full scale fire tested technology

Water Mist Systems

A significant reduction of smoke, an excellent blocking of radiant heat and a superior cooling of the tunnel structure are benefits of high pressure water mist systems. Multiple full scale fire tests have proven the efficiency for class A and class B fires.

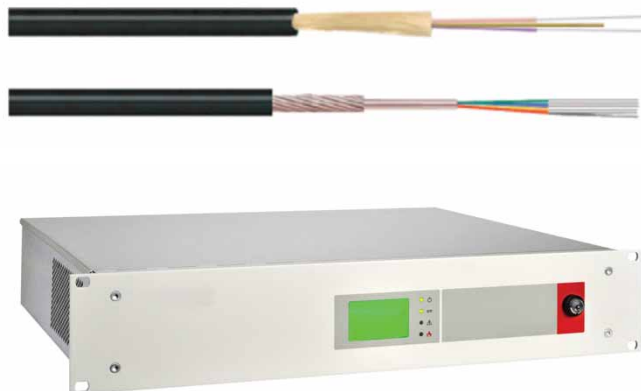
- ▶ *Effective fire suppression*
- ▶ *Prevention of fire spread*
- ▶ *Radiant heat blocking*
- ▶ *Tunnel structure cooling*
- ▶ *Reduction of smoke volume*
- ▶ *Beneficial for short and long tunnels*



Tunnel Safety Systems

FOGTEC's long experience in tunnel safety systems reflects in the design and implementation of other tunnel related systems. This includes, among others, SCADA and control systems, detection systems as well as RAMS and LCC analyses. FOGTEC is the first company that has installed SIL rated control systems for FFFS in tunnels.

In accordance with existing standards and fire brigade requirements, FOGTEC offers fully integrated fire alarm and detection systems, specially designed and tested for the use in tunnels. Our services include the design, supply, installation, integration and maintenance of various tunnel safety systems.





Fixed Fire Fighting Systems in tunnels

Lower costs and higher safety:

- ▶ *Improved level of life safety*
 - ▶ *Easier access for rescue services*
 - ▶ *Protection of the tunnel structure*
 - ▶ *High availability of the infrastructure*
 - ▶ *Same safety level at lower investment costs*
 - ▶ *Lower life cycle costs*
 - ▶ *Quick reopening after a fire*
 - ▶ *Reduction of insurance costs*
-

FFFS – Compensation potential

Passive Protection

Thanks to the superior cooling effect of FFFS the heat exposure to the tunnel structure is limited. Passive protection measures can be eliminated or minimized, whereby remarkable cost savings can be achieved.

Ventilation

Due to significant smoke reduction and cooling of the fumes after activating the FFFS, the ventilation capacity can be greatly reduced. In some cases longitudinal ventilation can be used instead of semi-transversal or transversal ventilation systems.

Others

A rapid activation of a FFFS minimizes damages throughout the tunnel, leading to reduced closure times and a higher availability of the infrastructure. Distances between emergency exits may be extended due to improved life safety conditions.



Tunnel safety research

FOGTEC has participated in major German and European tunnel safety research projects, funded by the German Federal Ministry of Economics and the European Union respectively.



The SOLIT2 research project (Safety of Life in Tunnel), funded by the Federal Ministry of Economics and Technology of Germany, focused on the compensation of traditional safety

measures in road tunnels with FFFS and their integration into an existing tunnel safety system.

The Engineering Guidance is recognised by ITA-COSUF as a valuable contribution to the industry and practice concerned with the improvement in operational safety in underground facilities. PIARC acknowledges the documents as useful guidance for the preparation of specifications.



The improvement of safety and fire protection in new and existing tunnels was the main target of the UPTUN research project.

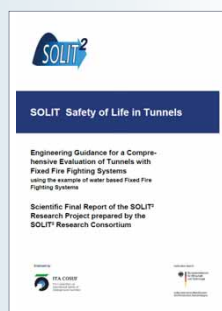
FOGTEC's water mist system was tested in full scale class A and class B fires.

The UPTUN Engineering Guidance, which was published as outcome of the project, is widely used for the design of water based FFFS.

SOLIT guideline

The SOLIT Engineering Guidance gives minimum criteria for the proper design of FFFS.

www.SOLIT.info



Fire Tests / Research

FOGTEC has carried out more than 200 full scale fire tests with fire loads of over 200 MW.

The test series included class A and class B fire tests with longitudinal and transversal ventilation settings.



EUROTUNNEL / CHANNEL TUNNEL (FRANCE / UK)

After two severe fires with extensive damage to the tunnel structure, Eurotunnel decided to improve its safety concept. Following successful tests with fire loads of over 200MW a FOGTEC water mist system was installed.

RAMS analysis confirms the FFFS availability of 99,98%.

RAMS studies were carried out to ensure the design availability of the system of over 99,98%. The innovative safety solution ensured its return on investment in less than two years.

The developed concept is an innovative safety measure for long rail tunnels.

Reference projects – road and rail tunnels

M30 MOTORWAY – MADRID (SPAIN)

Full scale fire tests were successfully carried out jointly with Madrid's fire brigade before receiving the order to protect vital parts of the M30 highway in Madrid.

Up to 22m wide tunnel areas are protected against severe HGV fires. In addition, numerous technical rooms are protected with FOGTEC's high pressure water mist system.

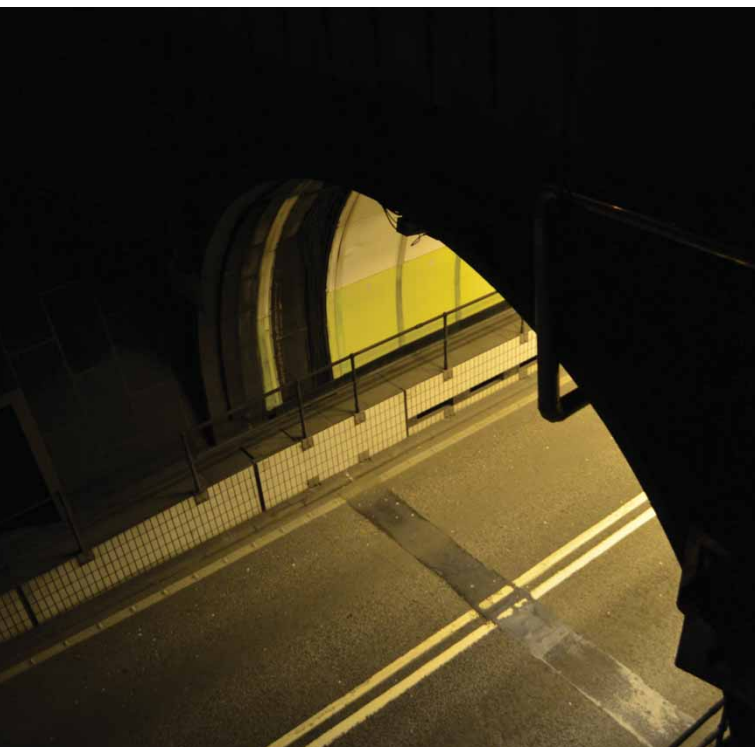


SAADIYAT TUNNEL – ABU DHABI (UAE)

A full scale tested FOGTEC water mist system has recently been installed to protect the Saadiyat Tunnel. The tunnel runs below the cultural district and connects, among others, the future Guggenheim and Louvre museums on the Saadiyat Island.

The installation was carried out by FOGTEC's partner in UAE. Thanks to the efficient suppression and smoke reduction potential of the water mist system, a smaller ventilation system could be used in this tunnel.





DARTFORD CROSSING – M25 HIGHWAY, LONDON (UK)

FOGTEC was appointed to protect both tunnel bores of the Dartford Crossing with a state-of-the-art high pressure water mist system. The contract included the development, design, manufacturing, installation, maintenance and commissioning of the FFFS. Prior full scale fire tests have proven the outstanding cooling effect of water mist, especially relevant for the protection of the cast iron structure of the older tunnel bore.

*FOGTEC installed the first SIL2 approved
fire fighting system in a tunnel worldwide*

To secure the high availability of one of England's most important and busiest transport link, the system has to fulfil SIL2 requirements. Redundant diesel driven pump stations, welded stainless steel piping and FOGTEC's patented remote service section valves are part of the sophisticated safety system.

NEW TYNE CROSSING, NEWCASTLE (UK)

A positive return on investment when installing a FOGTEC water mist system into the Tyne Tunnels was the outcome of a cost-benefit analysis. The installation into both tunnel bores was carried out in 14 weeks with only minor traffic interruptions.

*Safest tunnels in the UK after installation
of a FOGTEC water mist system.*

Thanks to the FFFS and other state-of-the-art safety measures the Tyne Tunnels were called as the safest in the UK.



VIRGOLO TUNNEL – BRENNER HIGHWAY (ITALY)

FOGTEC's first water mist system was installed in 2006 into the longest road tunnel on the Brenner highway. The system design is based on full scale fire tests and high quality materials. Diesel driven pump units operate the system independently from the electric power supply.

Almost ten years after installation, the FFFS has shown positive lifecycle costs with low maintenance requirements.





Cologne • Germany

