

FOGTEC Fire Suppression System put into operation in M 30 Tunnels of Madrid

Safer M 30 Tunnels

Parts of the M 30 tunnels belong to the safest tunnels in Europe. They are protected by state of the art Fire Suppression Systems. Unlike in most other tunnels, a fire would not be allowed to grow uncontrolled. Immediately after a dedicated fire detection system would have localized a fire, a Water Mist System would be activated to suppress the fire. Tunnel users do not have to rely solely on escape ways and the structural robustness of the tunnel.

FOGTEC in M 30 Tunnels

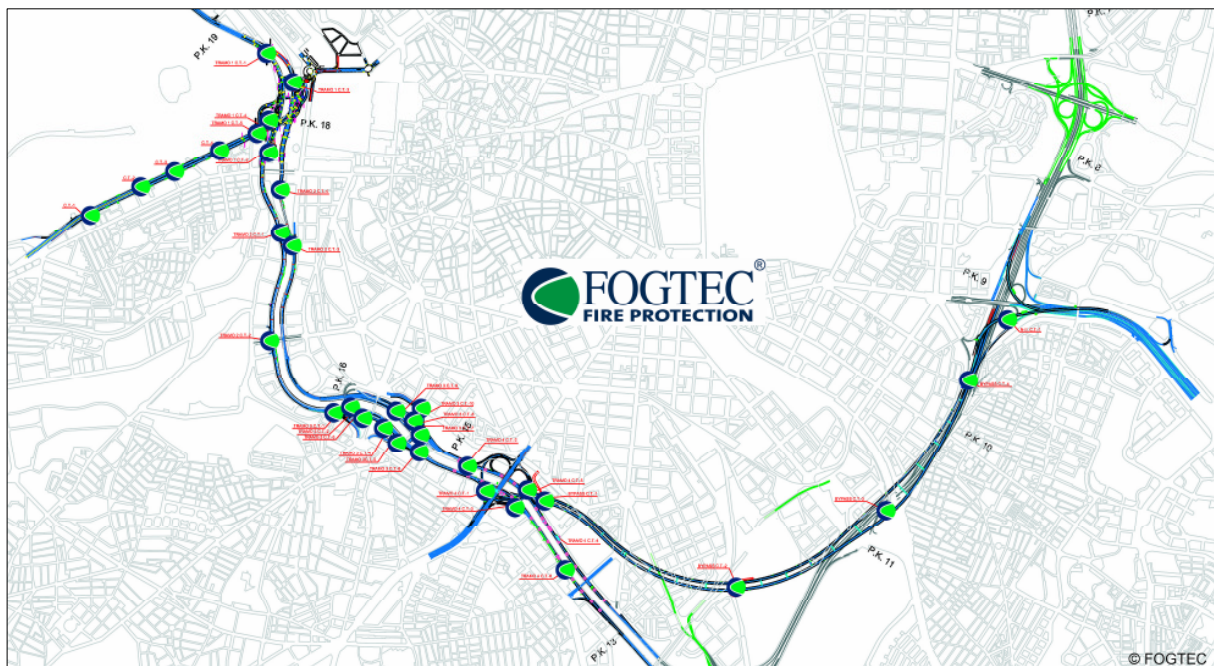
Since FOGTEC was awarded in 2006 the order for the protection of these critical sections of the M 30 tunnels with a Water Mist System, substantial parts have been added to the scope of work. As of today FOGTEC is protecting the by far largest part of the protected sections in the M 30 tunnels. In addition FOGTEC systems were chosen for 34

out of a total of 36 underground facilities connected to the main tunnel and containing technical equipment such as control systems, change over facilities, computer rooms etc. The below chart shows the locations of the FOGTEC protected areas.

FOGTEC also supplied state of the art Smoke Aspirating Systems for the equipment rooms. Sophisticated PLC-based control systems are provided by FOGTEC to ensure safe operation. These are integrated into the tunnels' main BUS-control system. Via ethernet interfaces the FOGTEC control systems are fully compatible with other tunnel equipment. PLC-substations distributed in the tunnels' escape ways connect the valve controls to the main BUS-network.

Successful acceptance test

Recently FOGTEC successfully passed the acceptance test for this important project by carrying out full scale spray tests in dedicated parts of the tunnels. In the presence of personnel of M30 and the main contractor Dragados the excellent performance of the



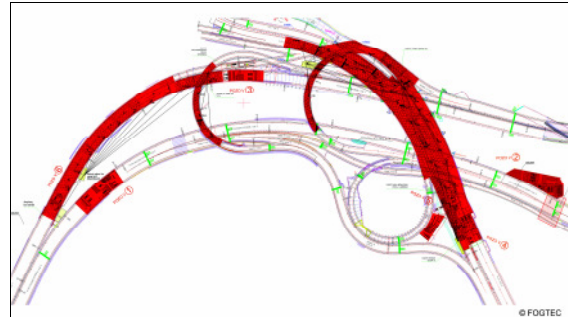
FOGTEC protected areas

The Smarter Way of Fire Fighting

FOGTEC Fire Protection ♦ Schanzenstraße 19A ♦ 51063 Köln (Cologne) ♦ Germany
Phone: +49-(0)-221-962 23 0 ♦ Fax: +49-(0)-221-962 23 30
www.FOGTEC.com ♦ contact@FOGTEC.com

FOGTEC system including the related controls was demonstrated.

The responsible project manager of Dragados, Federico Conde del Pozo, commented: "For several months Dragados has worked with FOGTEC on the concept for the protection of the tunnels before placing the order. We also attended full size fire testing in Asturias. After now having seen the way how FOGTEC integrated their system into the tunnels and the quality of work, we are convinced that Dragados made the right decision to recommend the FOGTEC system. We are very satisfied with the professional work."



FOGTEC tunnel protection (red areas)

This complex part of the project consists of several tunnels. The largest protected sections consist of five parallel road lanes with an overall tunnel width of 22 meters. In some sections 3 levels of the tunnels are protected by FOGTEC.



Spray test in M 30 Tunnels

The M 30 Project

The M 30 road is the inner ring motorway of the city of Madrid. It contains one of the largest tunnel projects ever with a total length of 56 km. The construction work has been started in September 2004 and will be finalized in summer 2007. FOGTEC is protecting 34 sensible technical rooms and approx. 2.1 km of the road tunnels.

The following chart indicates parts of the FOGTEC water mist system in the main tunnel.



FOGTEC system in M 30 Tunnels

Fire fighting performance

M 30 decided to protect high risk areas of the tunnels with the high pressure water mist technology after carefully performing feasibility studies. In order to ensure that a suppression system with the necessary effectiveness was chosen, the M 30 project council created a specific own fire scenario for full scale acceptance testing. Two high-pressure water mist suppliers were selected to carry out such tests in the research facilities of TST (Tunnel Safety Testing) in "San Pedro des Annes" in Northern Spain.

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Additionally, FOGTEC carried out extensive testing with the fire brigade of Madrid. Testing and training with this highly experienced fire brigade made an important contribution to adopt strategies for emergency cases in the tunnels. Various fire fighting strategies in conjunction with a number of ventilation conditions and operation of the FOGTEC system were tested in full scale.



SOLIT Fire Test in "San Pedro des Annes", Spain

At the same time the SOLIT (**Safety of Lives in Tunnels**) research consortium carried out major full scale fire tests in the facilities of TST. All tests for SOLIT were carried out with FOGTEC technology. This major research project gave further input for the design of the M 30 fire suppression system.

Soon after FOGTEC had successfully finalised fire testing at TST the order was placed in August 2006 with FOGTEC.

The layout of the FOGTEC system is identical with the parameters tested in full scale. For the safe protection of tunnels it is essential to comply with all major aspects - such as installation height of the nozzles, distance of nozzles to each other and to the walls – to what has been proven in full scale tests.

Protection in M 30 technical rooms

The M 30 tunnel project contains a large number of equipment rooms, which were decided to be protected with water mist systems as well. FOGTEC Fire Protection was selected to protect 34 equipment rooms. The technical proposal of FOGTEC with electric driven pump units was recognized to be

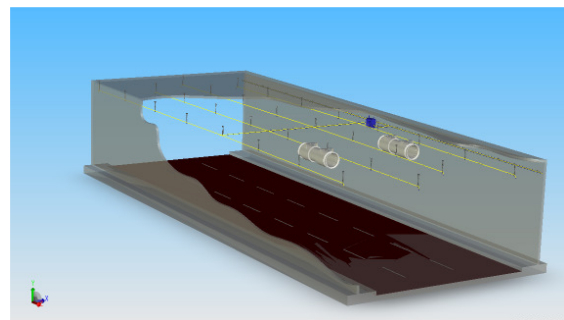
economical, effective and safe. The systems provide constant pressure of 120 bar without mixing gas to the water. Unlimited running times, reliable and simple design combined with low life time costs are the properties of these systems.

Components and system concept

As a general guideline for the design of the fire suppression system and its controls the "Guidance for Water Based Fire Fighting Systems for Sub-Surface Facilities, WP 251" – prepared as part of the European research project UPTUN – was applied.

All components chosen for the M 30 project have been tested prior to installation in full scale and in previous installations like in the Virgolo Tunnel of the Autostrada Brennero.

The FOGTEC system includes only open/deluge nozzles. The use of nozzles activated by heat sensitive glass bulbs has been avoided. This ensures that nozzles are activated at the intended locations and not where the heat may have been transported to by wind and ventilation. Further, life cycle costs can be reduced considerably because regular checks of the glass bulbs for damages caused by antennas or objects like stones are not needed.



3D CAD-Drawing of Tunnel-installation

All pipe work has been carried out in high grade stainless steel materials giving the required long lifetime.

The nozzles are installed throughout the protected areas. Sections of approximately 30 m length are activated simultaneously by section valves installed in fire proof cabinets under the ceiling. This position of the valves avoids the possibility of damages caused by trucks crashing into the walls of a tunnel.



Vital components shall not be installed at the walls

Special attention has been given to the valves. A regular test of the valves can be carried out from the tunnel control room without manual intervention at the valves. Thus, testing can be carried out with minimal time required and without closing a lane of the road way.

Two fully independent pump stations have been installed in two of the technical rooms. In total only 9 individual pumps are used to supply the required amount of water and to provide for two redundancy pump units. Thereby the number of individual components and moving parts has been minimized to provide highest reliability and lowest maintenance costs.

Control system

A sophisticated control system provided by FOGTEC links the fire suppression system to the main control system of the tunnels. A main PC provides all necessary information about the status of the fire suppression system to the tunnel control room. All functions of the FOGTEC system can be controlled from there. Sub-PLCs are positioned in the pump stations

and several staircases being part of the escape ways. From these sub-PLCs the connected section valves may be manually controlled by the fire brigade. In case of a failure of the main control system all sub-PLCs can be operated individually from each other.

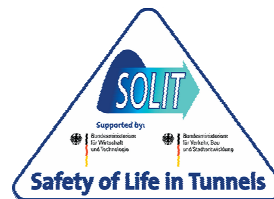
For further information:

www.FOGTEC.com

www.uptun.net (EU Project on Tunnel Safety)



www.solit.info (Safety of Life in Tunnels)



Press contact: Dirk.Sprakel@FOGTEC.com

How Water Mist works

Water Mist Systems fight fires with water in the form of very small droplets. Due to their extremely small size the surface of the droplets is huge in relation to the amount of water used. Via this surface the water rapidly absorbs heat and thereby cools the environment of the fire. Thus, the energy of the fire is reduced causing a suppression effect.

The Water Mist is generated by special nozzles which are supplied with water at high pressures. Robust pumping stations are able to supply the nozzles over several kilometers with the required amounts of water. Only small diameter pipes are required to transport the water due to the only small amounts of water needed. All piping etc. is made out of stainless steel.

FOGTEC, the Company

FOGTEC is a specialist for Water Mist Systems. The company has specialized in a number of applications such as tunnels, trains and industrial risks. Starting from consulting services and customer related research work FOGTEC offers turn key installations on an international scale in co-operation with local specialist companies.