Case reports of real fire accidents between 2016 and 2017 treated with water mist turbines

DR. ING. FRANCESCO FRITZ

WHO WE ARE

EmiControls

Who we are:

We offer tailor-made solutions in

- Firefighting and

- Dust suppression

using water mist.

EmiControls is part of the **TechnoAlpin Group**, which supplies ski resorts with turnkey snow-making systems and has become the world market leader in just a few years.

The sound know-how in mechanical engineering and above all in water atomization was also intended to be applied beyond ski slopes and in 2011 intensive research into fire protection and dust control began: EmiControls was born.

Where we are:

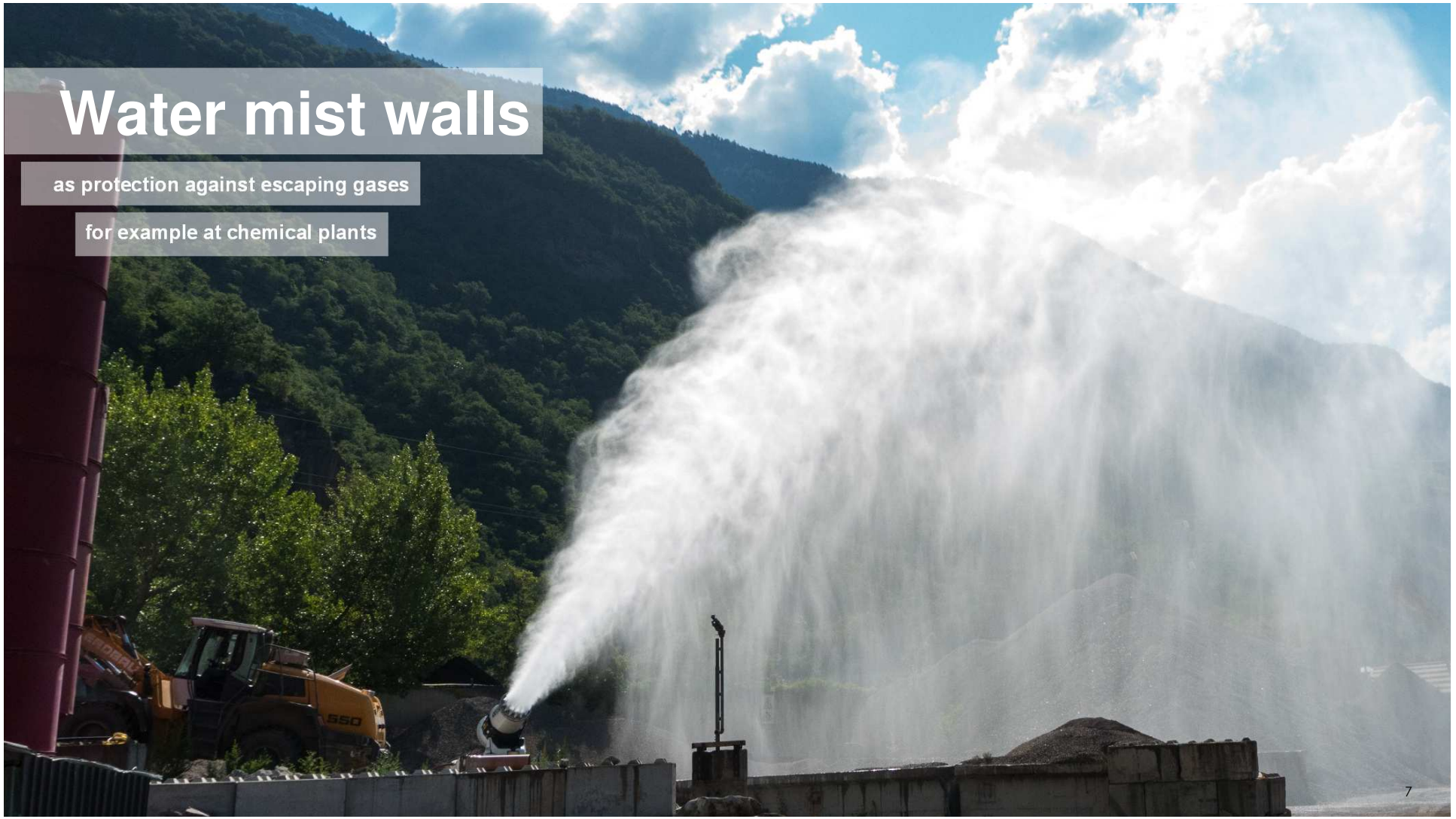
Our head office is located in Bolzano, South Tyrol (Italy)

BACKGROUND

Background

Water mist is known to be very effective for cooling, firefighting and gas mitigation purposes. Due to the low mass and low kinetic energy of water mist droplets, the **throw distance** of water mist nozzles is low if compared to traditional firefighting devices like monitor nozzles.

Firefighting turbines are high speed blowing devices that
-generate water mist and
-distribute it over 50-70m distance,
representing an efficient and water/foam saving technique for firefighting.


Water mist walls
as protection against escaping gases
for example at chemical plants


Coating objects
to reach even the most hidden fire herds

Admixture

works with water mist, foam or water-foam mixture

Benefits of Watermist Turbines

quick knock-down of flames and fire

reduced employment of water and foam

gentle application of foam on fuel surface

surrounding effect on objects

Turbine Aided Firefighting

- **Water mist flow**
  from 300 l/min to 4.800 l/min
- **Extinguishing medium**
  Water, salt water, Foam, Retarder, Gel
- **Manoeuvrability**
  360° rotation; -20°/+50° tilting
- **Power**: electric or oil-hydraulic

Types of Projection
long-range jet

- reach: up to 75m
- 0 – 3.600 l/min

Types of Projection
fine water mist

- reach: 50m
- 0 – 1.200 l/min

OBJECTIVE

Objective

Firefighting turbines are currently being used since few years in sites of chemical and petrochemical industries, tunnels, cities and forests in several locations around the world. Fire events are reported in newspapers, TV news, social medias.

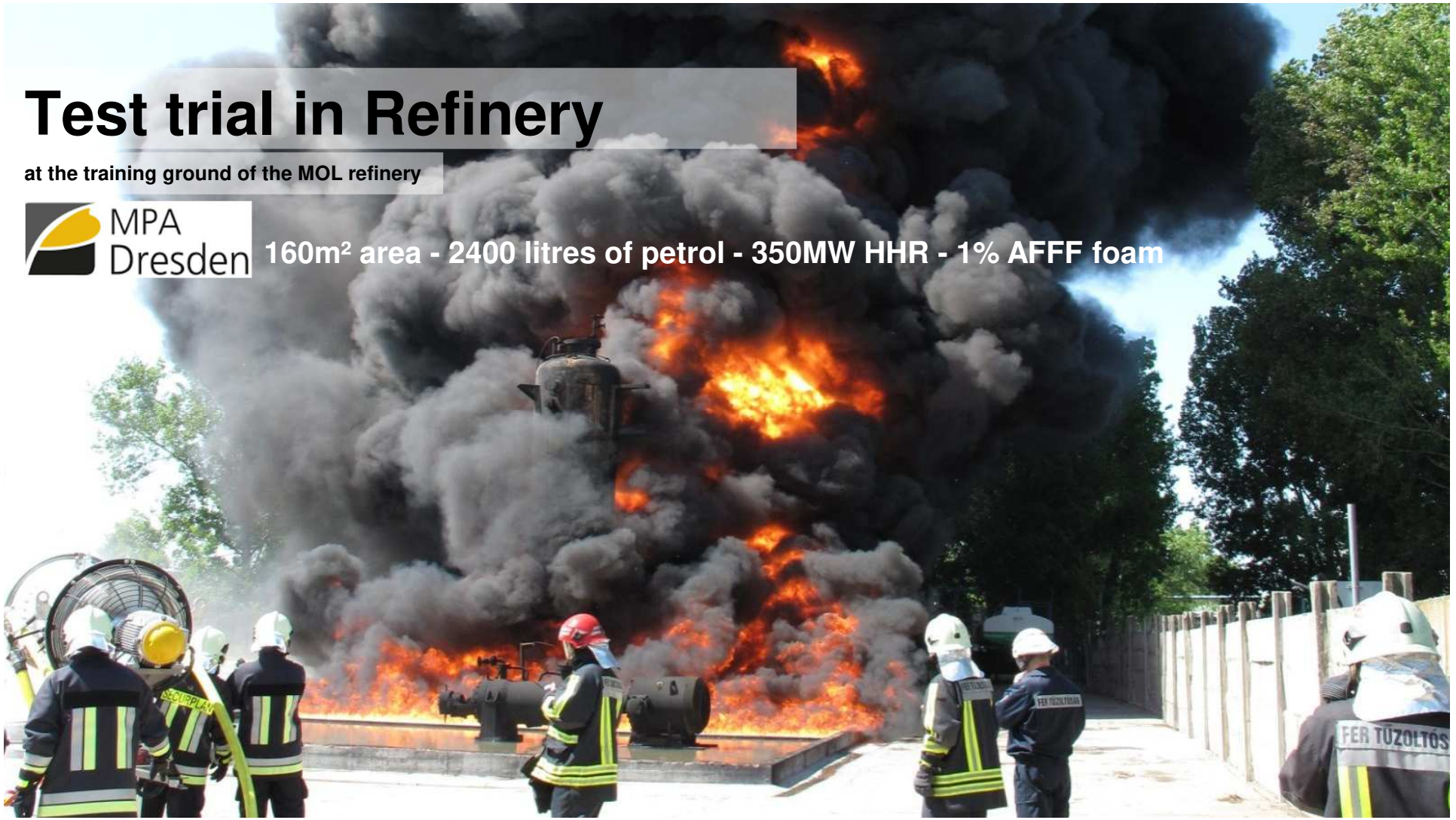
We wanted to obtain an overview directly from the end-users about how they employed the turbines in real fire accidents and what were the benefits and limits of the technique in relation to specific accident.

Test trial in Refinery

at the training ground of the MOL refinery

MPA Dresden

160m² area - 2400 litres of petrol - 350MW HHR - 1% AFFF foam

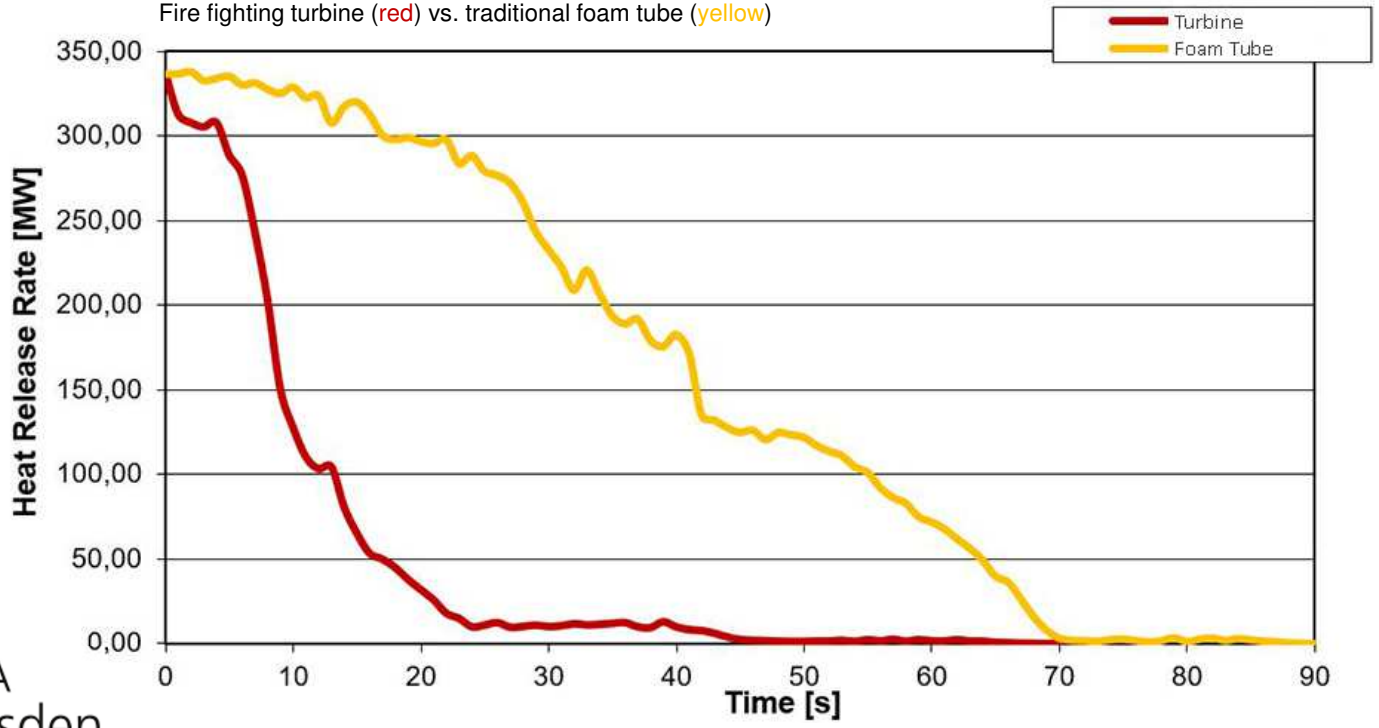



Test: 160m² surface - 2400l fuel – 350MW HHR – 1% AFFF foam

Results

The test in Hungary is the largest documented fire test using water mist in Europe. The table very clearly shows how quickly the heat was removed from the fire compared to conventional extinguishing methods. See the MPA Dresden certificate from 2012 on the next slides.

Fire fighting turbine (red) vs. traditional foam tube (yellow)



MPA Dresden

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METHOD

Method

We have asked **all our contacts** to send us reports about the employment of firefighting turbines in **real fire accidents** by describing:

(a) the circumstances of the accident,
(b) the main challenges they had to face,
(c) the benefit and limits (B&L) in this circumstance

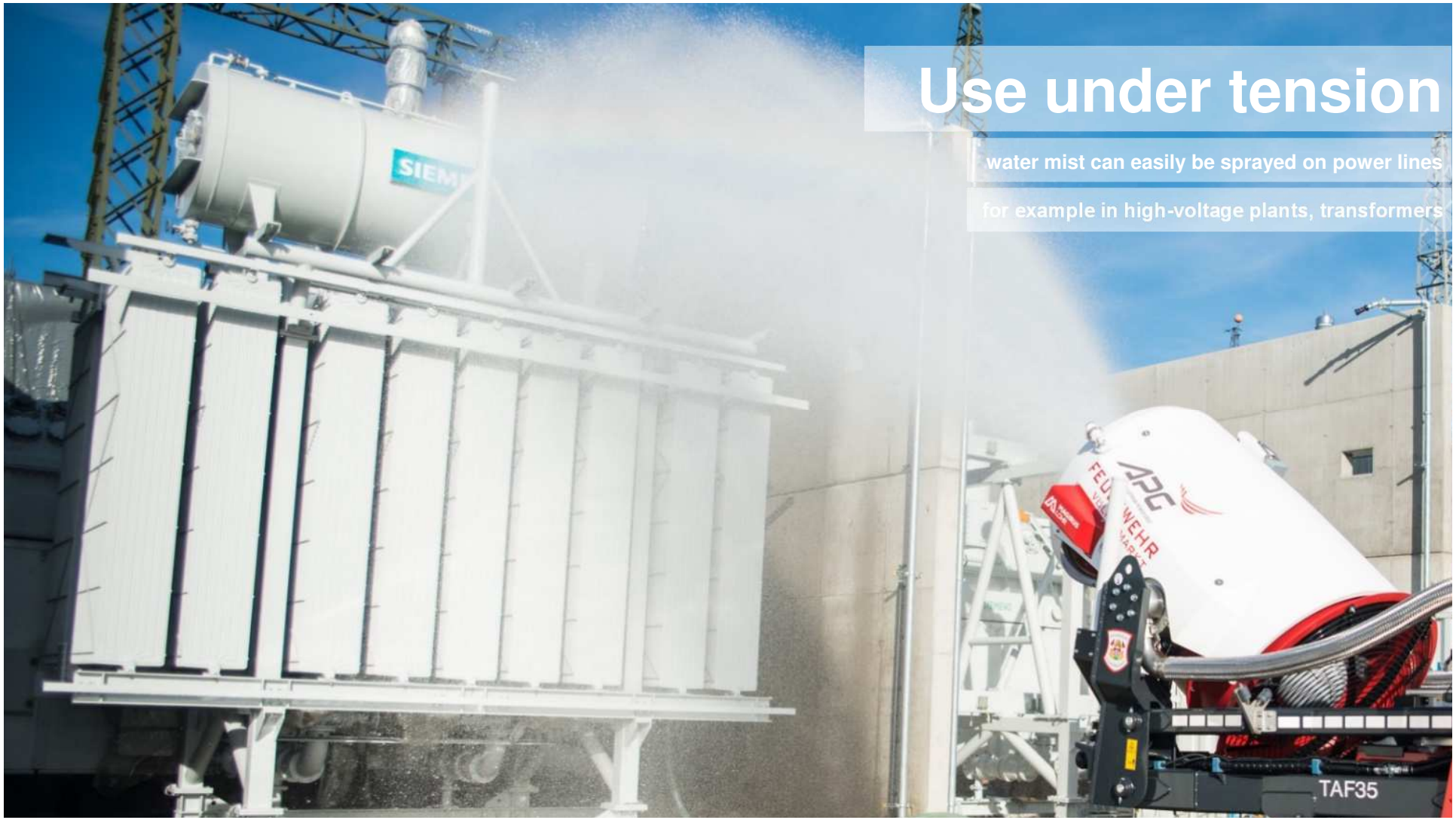
RESULTS

Power Grid– Austria

In October 2017 Austrian Power Grid (APG) has equipped their electric power transformation substation in Obersielach with a firefighting robot. The robot is part of a just developed security concept, as APG has recently bought a new 80/220-kV-transformer.

Advantages:

- Due to the fact that the turbine produces fine water mist and needs much less water, it can be used as well for electric power transformation substations.
- Due to the remote controlled TAF no firefighter needs to be close to the dangerous areas.
- In an case of emergency the firefighters safe much time, as no person is allowed inside the area without being accompanied by an APG worker. In this case the firefighters can now send only the robot in.



Use under tension

water mist can easily be sprayed on power lines

for example in high-voltage plants, transformers

User‘s Report

Power Grid – Austria
Circumstance: transformer site

Challenge: under tension parts, up to 220.000 V
60 ton cooling oil in each transformer

B&L: no current conduction thanks to water mist application, not possible with tradition monitors
no risk of fat-explosion in case of oil dropout

Chemical Industry Fire - Bavaria (Germany)

In July 2016 a fire developed in the chemical production site of the company in Burghausen (Germany) after the **leakage** of a corrosive and flammable liquid, which immediately combusted. Initial extinguishing attempts were only moderately successful. However, the fire was completely extinguished mere minutes after the watermist turbine was brought onto the scene.

Interview with Fire Brigade commander

- The robot can **get closer** to the hot spots, thanks to the camera system, the infrared cameras and the remote control. The operator can stay up to 300 meters away from the robot.
- While **repositioning** the robot, the operation can still go on as the turbine can be used while the robot is moving.
- The robot is very flexible and agile, which is very important during an operation. Thanks to the lift arm the robot can conquer possible **obstacles** (such as dividing walls, switchboard and other objects).
- Very important: the robot has a limited noise emission, therefore the **communication** between the firefighters is always possible.

User‘s Report

Chemical industry fire – Bavaria (DE)

Circumstance: spill of trichlorosilane gas followed by fire.

Challenge: traditional foam attack wasn’t working;
additionally, trichlorosilane reacts violently if it gets in contact with water.

B&L: suffocation of fire with high quantity of water mist, driven “chirurgically” through thermal camera and remote control, keeping firefighter on save distance from this very dangerous situation.

even higher amounts of watermist (>4.800 l/min) would be appreciated

Urban Fire - Sydney (Australia)

In summer 2016 a building in Sydney has caught fire. 80 firefighters were battling the flames and could prevent them from spreading, as well with the help of a TAF35.

Statement in the News:

"The remote controlled fire fighter was very effective in tackling those flames. It uses a mixture of foam and water propelled by high powered fans. It did a very good job. It got much closer to the building than firefighters possibly could because of the radiant heat"


7
NEWS

User‘s Report

Factory fire - Sydney (AUS)

Circumstance: Factory caught fire in urban area, evacuation of neighbor buildings.

Challenge: high amount of heat, risk of collapse of structure.

B&L: could get close to the heat source to cool down heat, with no risk to FF crew

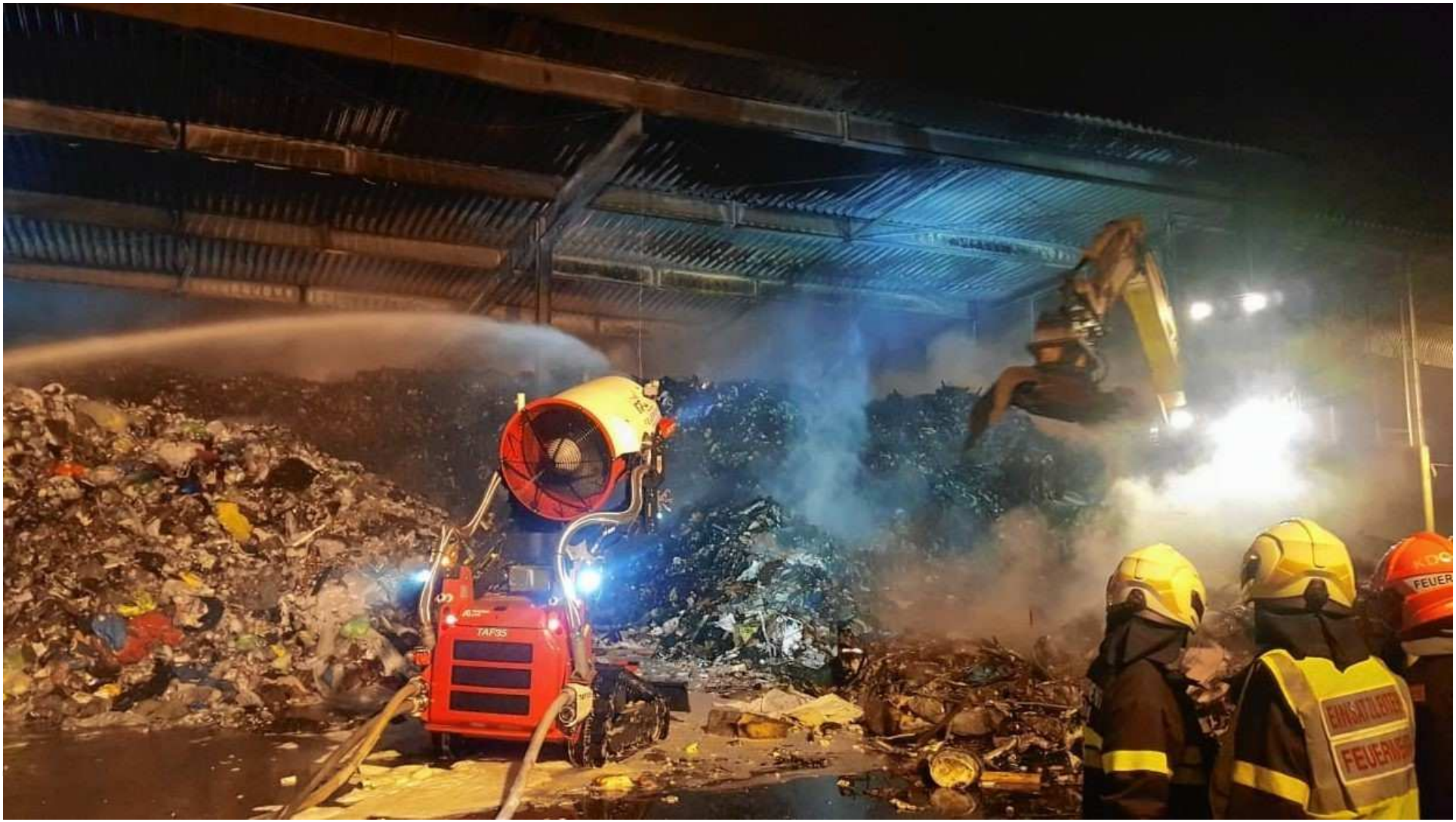
management of hoses can be complex for higher distances

Fire in Recyclig Centre – Tainach (Austria)

End of May 2018 a huge fire developed in an Austrian Recycling Centre. 150 fire fighters from 9 different fire departments helped to bring the fire under control, as well as our fire fighting robot TAF35.

Use of turbine:

- In order to reach the hidden fire sources deep in the waste piles, the waste had to be teared apart. The turbine was used to delete the small piles of rubbish step by step with water and foam.


TAF35
EINSATZLEITER
FEUERWEHR


ORF.AT
K HEUTE

User‘s Report

Fire in Recyclig Centre – Tainach (Austria)

Circumstance: recycling center caught fire around midnight for unknown reasons

Challenge: fire already widely extended, when FF reached the site
high fire load, dense concentration of material

B&L: high cooling efficiency with little water consumption

Forest Fire - Sardinia (Italy)

The hot temperatures and the lack of rainfall in summer 2017 have caused fires in large parts of Italy. Our **turbine** was installed on **4 × 4 trucks** and brought to Sardinia and Calabria in August for testing. The tests were very positive.

Advantage:

- Water mist needs much less water than traditional methods. Particularly in the case of forest fires, water deficiency is always a big problem.
- The turbine was tested in pulse mode
- the tests were especially successful at the forest boundaries – fire fighters could avoid the fire to overlap to urban areas
- By attaching the turbine to the 4 × 4 trucks, servicemen can get to the fire sources as quickly as possible, even in rough terrain, and prevent further encroachments quickly.

User‘s Report

Forest fires – Sardegna (IT)

Circumstance: 2017 was a very hot summer; record number of forest fires reached.

Challenge: number of fires vs. people and means available.

B&L: effective water-saving firefighting in “pulse” mode, especially in interface fires;

total water amount of water carried shall be increased.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Source: Corpo forestale e di vigilanza ambientale – Regione autonoma della Sardegna

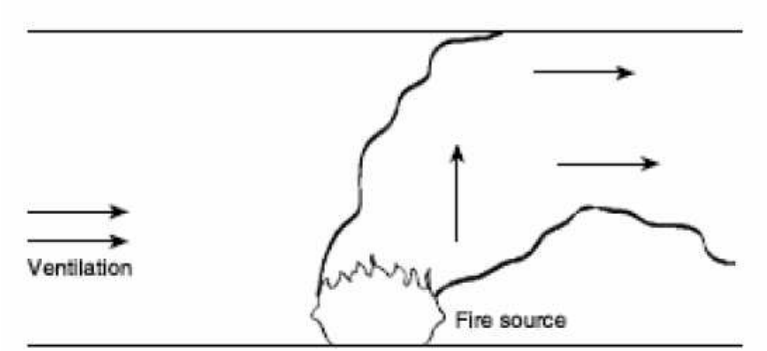
Tunnel Fire – Gleinalm in Graz (Austria)

In August 2016 a bus has caught fire in a tunnel in Austria. The situation was extremely dangerous as the heat was enormous and parts of the concrete floor chipped.

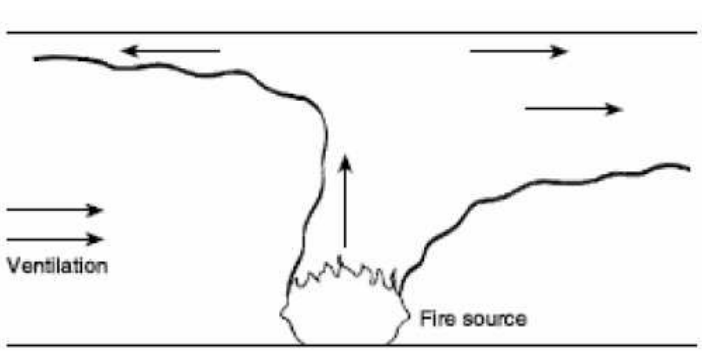
Statement Fire Chief (TV Interview):

„We are just about to do the dumping-down operations and try to cool the tunnel system down. We use now our special tool (TAF) to cool the concrete floor down.“


Brand
Fire



no back layering

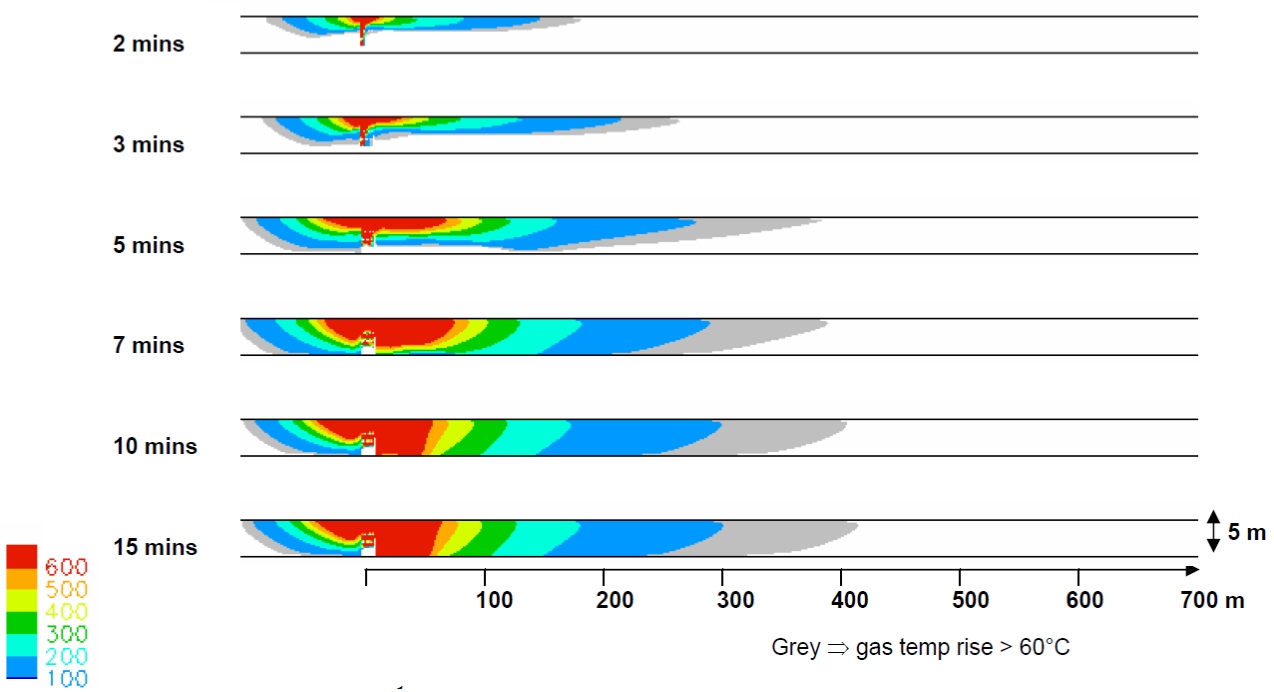


back layering present

Source: "UPTUN, Workpackage 2 Fire development and mitigation measures D214, CFD modelling of tunnel fires ", Stewart Miles, Garston, Juli 2006

Appendix J – Contour plots of gas temp rise for box section and 150 MW fire

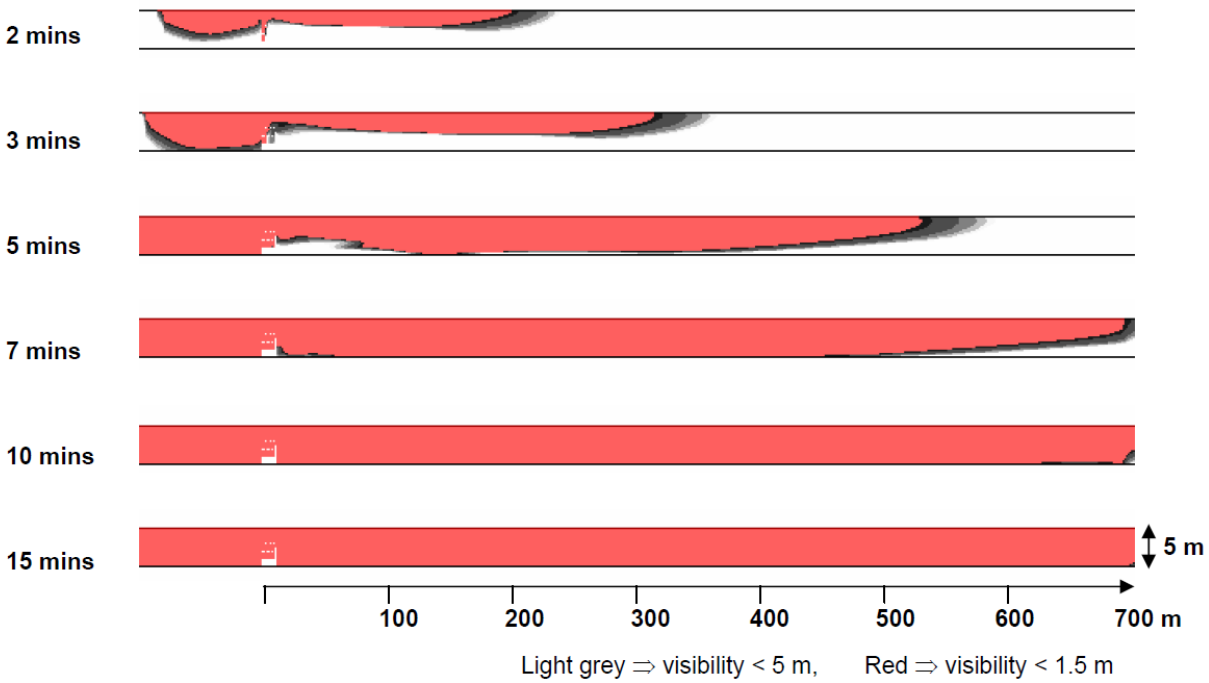
2x100N ventilation ***(1.1 ms^{-1} pre-fire velocity)***



Source:
"UPTUN, Workpackage 2 Fire development and mitigation measures D214, CFD modelling of tunnel fires ", Stewart Miles, Garston, Juli 2006

Appendix K – Progress of smoke front for box section and 150 MW fire

2x100N ventilation ***(1.1 ms^{-1} pre-fire velocity)***



Source:
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Brandleistungen bei Brandversuchen nach Haack 2001

Brandleistung (MW)						Brandtests				
	PIARC		RABT	CETU (F)	NFPA 502	Eureka		Runehamar	Memorial geschätzt	Erwartung *
	1997	1999	1994	1996/97	1998	real	Ingason Bericht			
PKW (gr)	5			2,5	5	1,5 - 2				
Pkw (gr)				5						
Van (Plastik)		2,5 - 8				5 - 6	2,5 - 9			3 - 10
1-2 Pkw			6 - 10							
2-3 Pkw				8						
Van (Plastik)		15		15						
1 Bus		20			29 - 34	29 - 34				36
Bus, Lkw ohne Gefahrgut	20		20 - 30	20	20				20	
HGV				30		100 - 130	128			150 - 400
Benzintanker	100	100	50 - 100	200	100		10 - 100			120 - 300
Benzinlache 400l									50	
Benzinlache 800l									100	
Michladung 2900kg						15 - 17				
versch. HGV								71 - 223		
Waggon						12 - 47				3 - 100

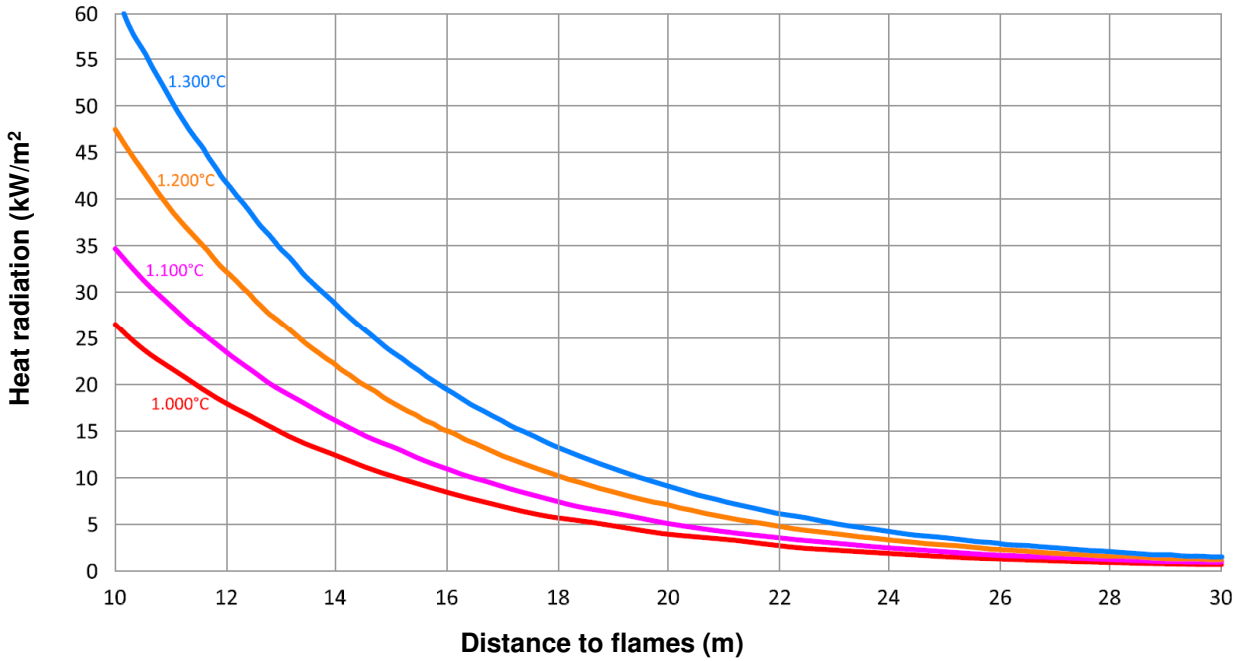
Source: "Untersuchung der Bedingungen für die Feuerwehren bei der Bekämpfung von Bränden in Verkehrstunneln unter Berücksichtigung der in den Risikoanalysen der OECD-PIARC zugrundeliegenden Brandszenarien für verschiedene Unfälle", Dr. rer. nat. Georg Pleß, Dipl.-Chem. Ursula Seliger, Institut der Feuerwehr Sachsen-Anhalt, Heyrothsberge, Mai 2009

Impact of heat radiation on firefighting crew

Heat radiation [kW/m²]	Impact on firefighting crew
1,5	Longer operations are possible. Enough time to arrange needed logisics.
4,5	FF personnel can operate for longer time with normal protecting clothes.
8	FF personnel can operate only for short time and only with special protecting equipment.

Quelle: "Untersuchung der Bedingungen für die Feuerwehren bei der Bekämpfung von Bränden in Verkehrstunneln unter Berücksichtigung der in den Risikoanalysen der OECD-PIARC zugrundeliegenden Brandszenarien für verschiedene Unfälle", Dr. rer. nat. Georg Pleß, Dipl.-Chem. Ursula Seliger, Institut der Feuerwehr Sachsen-Anhalt, Heyrothsberge, Mai 2009

Heat radiation (kW/m²) vs. Distance (m)



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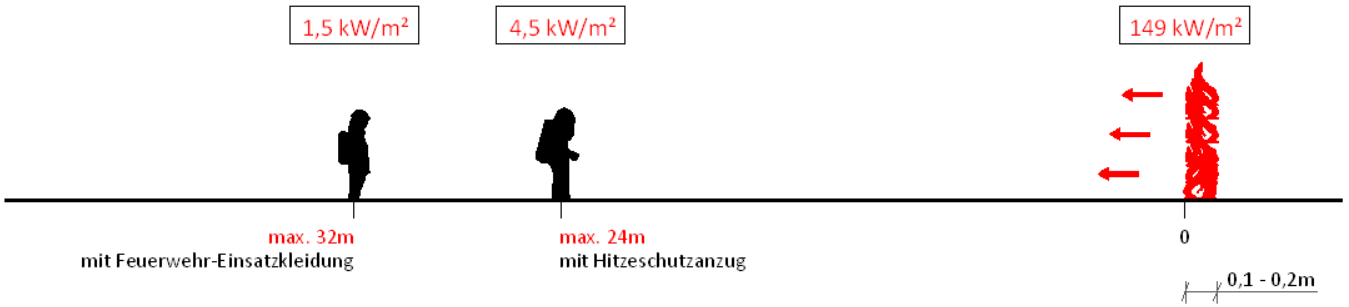
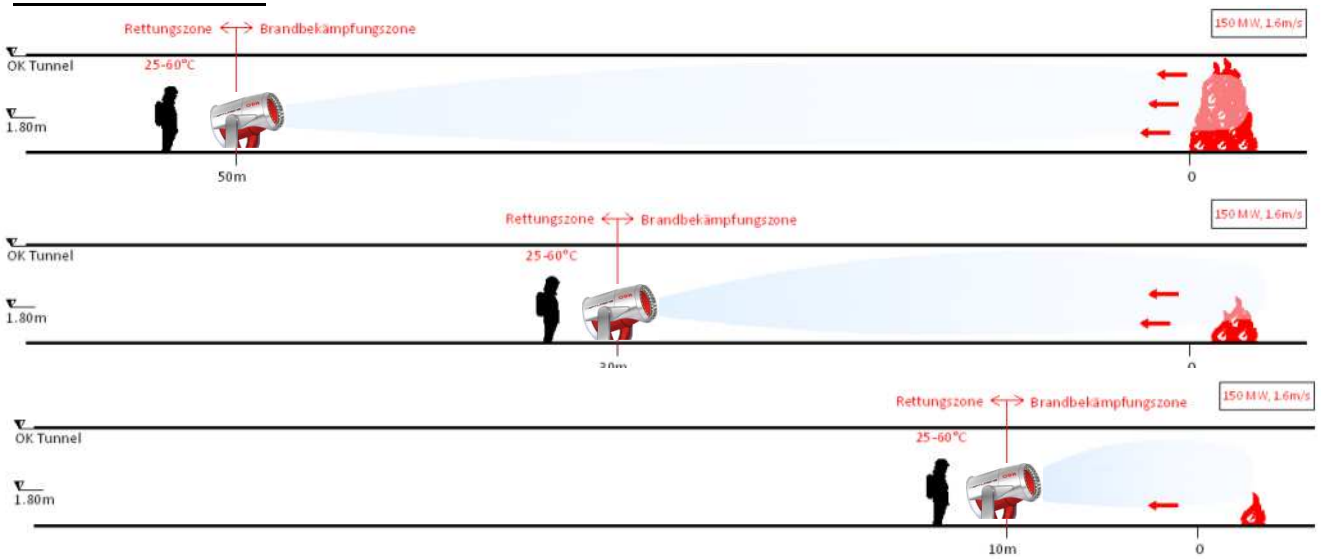
Operating distance for firefighting crew for 150MW fire



With Watermist



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Report

Tunnel fire – Graz (AT)

Circumstance: Bus started to burn, then burned completely out inside the tunnel.

Challenge: more than 1000°C and smoke.

B&L: could cool down temperatures and mitigate the damages on the tunnel's structure.

management of hoses for longer distances (>200m) may become tricky

CONCLUSIONS AND RECOMMANDATIONS

Conclusions and recommandations

Water mist was the **key success factor** in all reported cases. Thanks to its capability of cooling structures, suffocating fire and extinguishing efficiently many type of fire including oil and electric fire and thanks to the safety that water mist is able providing, new approaches to threat fire accidents were possible.

The **challenge** is to make water mist available at the **right place in the right quantity**. New automatization and robot technologies are becoming available and may make this task become easier in future.

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