



5<sup>th</sup> International Seminar on Underground Space  
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Portuguese National Authority standpoint  
regarding the safety of tunnels in operation

Pedro Silva Costa, IMT,IP, [pcosta@imt-ip.pt](mailto:pcosta@imt-ip.pt)  
Paula Domingues, IMT,IP, [pdomingues@imt-ip.pt](mailto:pdomingues@imt-ip.pt)



FGU Fachgruppe für Untertagbau  
GTS Groupe spécialisé pour les travaux souterrains  
GLS Gruppo specializzato per lavori in sotterraneo  
STS Swiss Tunnelling Society

# Portuguese National Authority standpoint regarding the safety of tunnels in operation

1. Introduction
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3. Institutional Framework
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5. Periodic inspections
6. Periodic exercises
7. Conclusions

# 1. Introduction (I)

- > The **Directive 2004/54/EC on minimum safety requirements for tunnels** in the Trans-European Road Network (TERN) applies to all tunnels longer than 500 m, whether they are in operation, under construction or at the design stage
- > The Directive has been transposed into national law by the **Decree Law (DL) 75/2006** (which has been updated since then); beyond transposing the Directive, Portugal decided to apply its provisions **also to tunnels existing on the national road network (NRN), with a length greater than 500 m**
- > In 2014, the Decree-Law was reviewed regarding the time limit for **refurbishment** (to be compliant) of tunnels of the NRN already in operation, which has been **postponed from 2014 to 2020**

# 1. Introduction (II)

## > The Directive and the DL 75/2006

- create a **structure and responsibility chain**:
  - ✓ Administrative Authority
  - ✓ Tunnel Manager
  - ✓ Safety Officer
  - ✓ Inspection Entity
  
- lay down **technical and organizational requirements** covering the design, construction, entry into service/operation and refurbishment of road tunnels
  
- establish maximum time intervals for:
  - ✓ periodic **inspections** (not to exceed 6 years)
  - ✓ periodic **exercises** (not to exceed 4 years)

## 2. The Portuguese road tunnels (I)

> Seven Portuguese tunnels fall into the scope of DL 75/2006

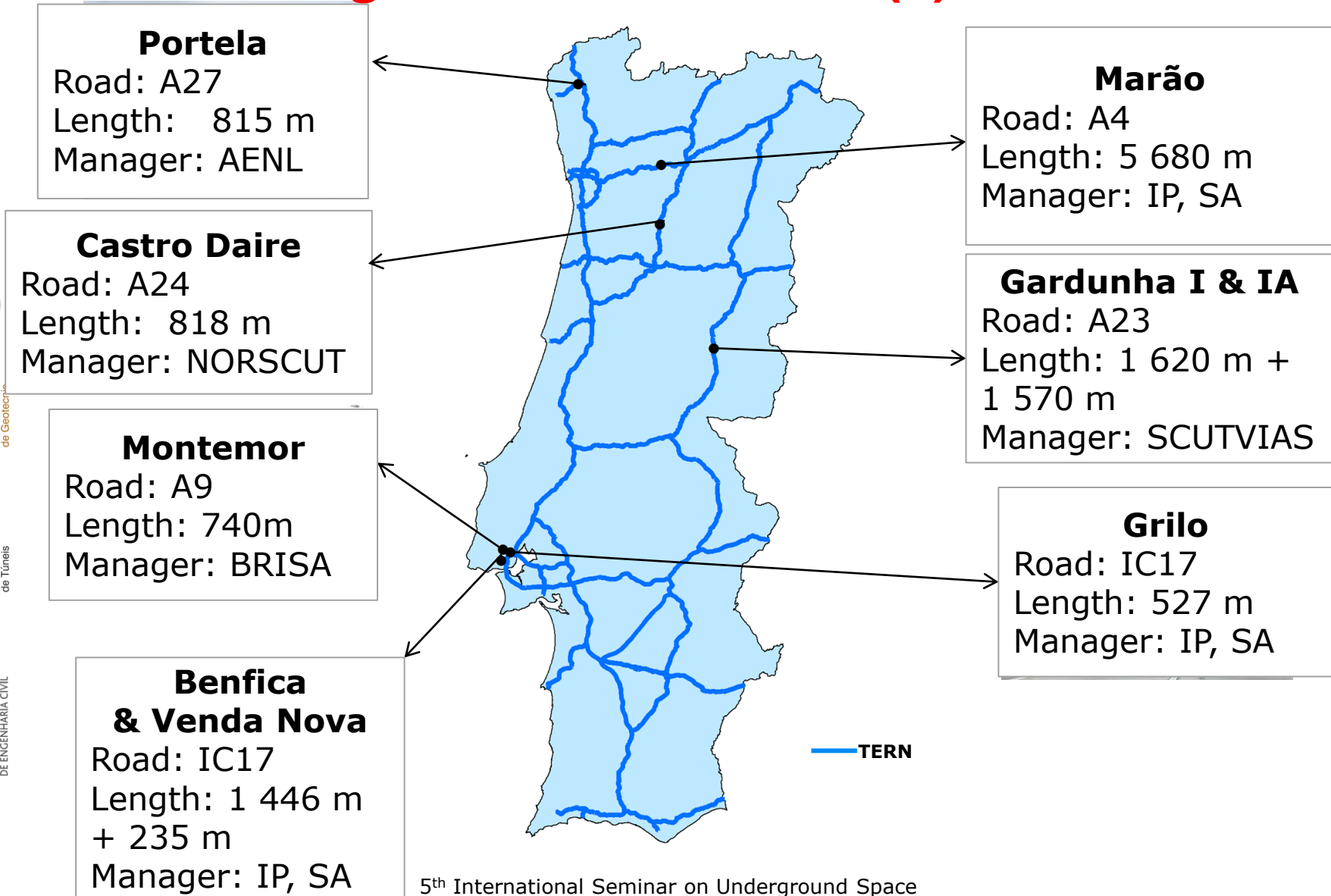
- **Four in motorways which are part of the TERN**

- ✓ Marão, A4
- ✓ Gardunha, A23
- ✓ Castro Daire, A24
- ✓ Portela, A27

- **Three in roads which are part of the National Road Network (NRN) not comprised in the TERN**

- ✓ Grilo, IC17
- ✓ Benfica and Venda Nova, IC17
- ✓ Montemor, A9

## 2. The Portuguese road tunnels (II)



## 2. The Portuguese road tunnels (III)

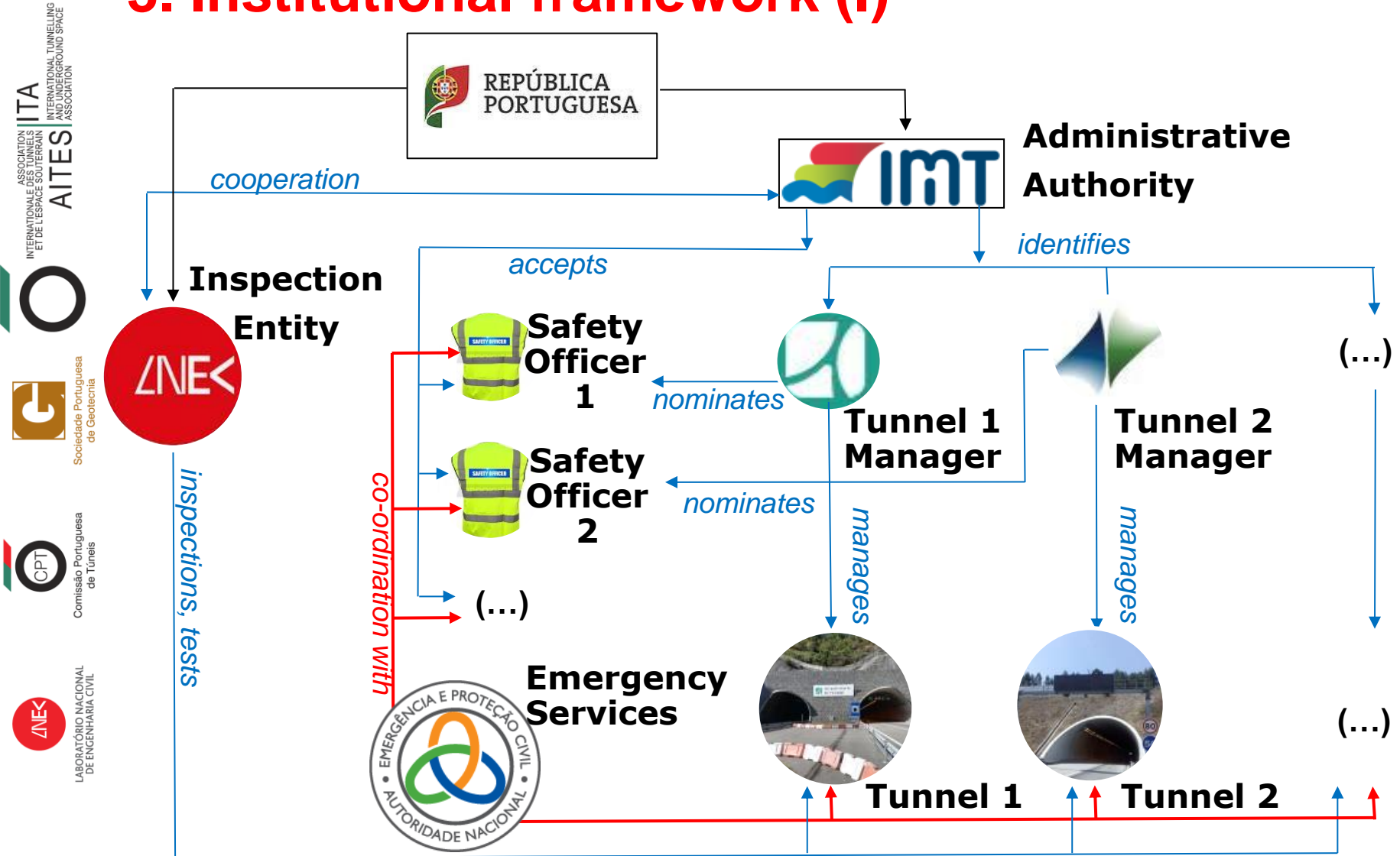
### Main characteristics of the tunnels

Tunnel	Road	Network	Length (m)	Build year	Number of lanes (*)	Tunnel Manager
Marão	A4	TERN	5 680	2016	2X2	IP, SA
Gardunha I & IA	A23	TERN	1 620 1 570	2003 1997	2X2	SCUTVIAS
Castro Daire	A24	TERN	818	2002	2X2	NORSCUT
Portela	A27	TERN	815	2004	2X2	AENL
Benfica & Venda Nova	IC17	NRN	1 446 235	2011	2X3	IP, SA
Montemor	A9	NRN	740	1995	2X3	BRISA
Grilo	IC17	NRN	527	1998	2X4	IP, SA

(\*) All tunnels with 2 galleries



# 3. Institutional framework (I)



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## 3. Institutional Framework (II)

- > IMT is the **Administrative Authority**, responsible for ensuring road tunnels safety, as per the provisions of the Directive
- > Who is IMT ? It has a **vast number of other responsibilities in the areas of mobility and transport**; just to mention a few:
  - issuing drivers' licenses, and authorising and inspecting driving schools
  - licensing and monitoring official vehicles' inspection centres
  - authorising special transports on national roads
  - maintaining the national register of license plates and vehicle type approvals
  - acting as National Rail Safety Authority
  - acting as National Road Authority
  - managing, on behalf of the Grantor, all the concession contracts of national roads (in Portugal, the whole NRN is concessioned)

## 3. Institutional Framework (III)

- > As the road tunnels' **Administrative Authority**, and within the scope of its competencies, IMT is responsible for:
- authorising the initial opening or re-opening of a tunnel to public traffic
  - suspending or restricting the operation of a tunnel if safety requirements are not met
  - approving the safety documentation
  - ensuring that periodic inspections are performed on a regular basis
  - ensuring that periodic exercises are performed on a regular basis
  - implementing the necessary risk reduction/mitigation measures
  - reporting on fires and other incidents/accidents in tunnels

# 4. Incidents in Portuguese road tunnels (I)

## Incidents – 2017-2018

Tunnel	Road	Network	Length (m)	Number of lanes	Incidents	
					Fire	Other
Marão	A4	TERN	5 680	2X2	5	2
Gardunha I & IA	A23	TERN	1 620 1 570	2X2	-	-
Castro Daire	A24	TERN	818	2X2	-	1
Portela	A27	TERN	815	2X2	-	-
Benfica & Venda Nova	IC17	NRN	1 446 235	2X3	-	9
Montemor	A9	NRN	740	2X3	-	1
Grilo	IC17	NRN	527	2X4	1	6

## 4. Incidents in Portuguese road tunnels (II)

- > In 2017-2018, some **25 incidents** occurred in the mentioned Portuguese tunnels, with no fatalities
- > The **majority of the incidents were due to heavy traffic**, occurring in tunnels (Grilo and Benfica) located in urban areas, and which are central, or are part of, many intersections (leading to lane changes inside the tunnels)
- > Nevertheless, **in Marão there were 5 fire events**, mainly due to vehicles getting to the tunnel already overheating, after a significant ascent; fires were then initiated inside the tunnel or just at the portal; a firebrigade vehicle is now at all times at the tunnel, since response times of emergency services were still insufficient, and the tunnel manager is preparing to invest in a pre-tunnel overheat detector

## 5. Periodic inspections (I)

- > What assessment methodology, for evaluating compliance?  
On this, we stand by LNEC.
- > Verification of design solution adequacy
- > Verification of the tunnel compliance with the project and proof of its adequacy
  - by document analysis
  - by visiting the tunnel and its facilities
  - experimentally whenever possible
  - analytically when necessary
- > Verification that tunnel operation meets the legislation requirements  
(documents; procedures; responsibilities)
- > Assessment of the interactions with external entities (Emergency Services)

## 5. Periodic inspections (II)

> Verification of compliance with the following safety requirements:

- structural measures: structure, emergency exits, emergency passages, drainage for flammable and toxic liquids, etc.
- lighting
- ventilation
- emergency stations
- water supply
- control centre
- monitoring systems
- road signs
- equipment to close the tunnel
- communication systems
- power supply
- fire resistance of equipment
- operating means
- safety documentation

## 5. Periodic inspections (III)

- > The assessments by LNEC included the following stages / actions
  1. Technical inspection of the equipment and safety systems in the galleries of each tunnel, in the technical buildings and in the control centres
  2. Visual inspection of the equipment and safety systems
  3. Verification by testing the equipment and safety systems



## 5. Periodic inspections (IV)

- > The assessment comprised the following stages / actions (cont.)
  4. Drainage system inspection
  5. Structure inspection
  6. Verification by testing the functioning of key active resources, their interactions and their combination with human intervention





# 5. Periodic inspections (V)

> The assessment comprised the following stages / actions (cont.)

## 7. Report draw up



## 5. Periodic inspections (VI)

- In **2007**, in existing tunnels (in operation before DL 75/2006)
  - Gardunha (TERN)
  - Castro Daire (TERN)
  - Portela (TERN)
  - Grilo (NRN)
  - Montemor (NRN)
- In **2014**, in TERN tunnels
  - Gardunha
  - Castro Daire
  - Portela
- In **2016**, in NRN tunnels
  - Grilo
  - Montemor



## 5. Periodic inspections (VII)

- > As a result of the reports of the inspections carried out, the tunnel managers proposed corrective measures that resulted, or will result, in the following **investments**:

Investments (€)	TERN				NRN		
	Castro Daire	Gardunha I & IA	Portela	Marão	Montemor	Grilo	Benfica V.Nova
Compliance with DL 75/2006	26 k	670 k	(a)	(a)	5 M (b)	10 M (b)	(a)
Other works	553 k	280 k	-	-	-	18 k	-
Other works – over next 3 years	-	400 k	95 k	600 k (c)	-	-	-

(a) Tunnel already built in compliance with Directive 2004/54/EC

(b) Tunnel to be refurbished by December 2020

(c) Mainly, a heat detector to be installed outside the tunnel portal (ascending road)

## 6. Periodic exercises (I)

- > In accordance with the DL 75/2006, periodic exercises shall be conducted for tunnel staff and the Emergency Services.
- > Full scale exercises under conditions that are as realistic as possible shall be conducted in each tunnel at least every four years.



## 6. Periodic exercises (II)

- Periodic exercises have been performed in all Portuguese TERN tunnels and in two of the NRN tunnels
- The exercises were organized by the respective Tunnel Managers, in collaboration with the Emergency Services and Safety Officer
- Although the Administrative Authority and the Inspection Entity were not always involved in the organization, both participated in most exercises as observers



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## 6. Periodic exercises (III)

### > Lessons learned (I)

- The involvement of the **Administrative Authority** and the **Inspection Entity** in the periodic exercises is essential:
  - As **advisers** in the preparation of the periodic exercises, to avoid concentration of tests on **Emergency Services procedures** and only briefly testing the tunnel's equipments, the procedures followed and the operators response
  - As **technical observers** (not just VIP "official" observers), to be able to make a technical assessment of the operation and the way the safety systems work, and of the performance of the internal actors involved in tunnel management



## 6. Periodic exercises (IV)

### > Lessons learned (II)

- some Tunnel Managers still operate tunnels as if they were “motorways with a ceiling” (a pure road operation view) – work still to be done on “mindsetting”
- timing of critical factors: the emergency call and the tunnel closure decision (**why is still so hard to push the red button?**)
- the tunnel manager must not schedule his best control centre operator for every exercise
- briefing and debriefing with Emergency Services still have much room for improvement
- performing internal exercises is of the utmost importance



## 6. Periodic exercises (V)

➤ Performing “**internal only**” drills, without the presence of firebrigades, police and rescue teams, allows to **focus** on evaluating and improving **all operating issues that should occur before emergency services arrive and take charge**:

- performance of the first-warning tunnel safety systems
- adequacy of the tunnel safety procedures, and times of response of the internal teams, **at the control centre and on site**
- **defining moments**: the emergency call and the tunnel closure decision
- compliance with the **Internal Emergency Plan**, and any improvements needed
- communication with “**walking victims**” and their evacuation
- any coordination & communication constraints
- **best use of small “time window” to make a difference**



## 7. Conclusions (I)

- > The national Decree-Law 75/2006, transposing the Directive 2004/54/EC, and updated afterwards, establishes a set of minimum safety requirements for tunnels over 500 m, both for TERN and NRN
- > In 2014, the mentioned Decree-Law was reviewed in what concerns the limit date for refurbishment of tunnels of the NRN already in operation, postponed from 2014 to 2020
- > Of all 7 national tunnels in the scope of that law, 5 are already compliant, and just 2, on the NRN, are still on a refurbishing phase, but are expected to be compliant by the limit date, December 2020



## 7. Conclusions (II)

- > From the standpoint of the Administrative Authority, the assessments undertaken pinpoint some **critical factors**:
- **the Administrative Authority (IMT) should keep teaming up with the Inspection Entity (LNEC);** we have the road operation knowledge, they have the tunnel technical expertise
  - need for a **wider technical awareness of each tunnel emergency operation**, by all operators, at all times
  - still **vulnerabilities in internal response**
  - need for **regular training actions and more internal drills** (in addition to the complete exercises involving the Emergency Services)

**In serious and life threatening incidents, tunnel managers have only a very limited “time window” to make a difference – they should make the most of it!**



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## Thank you

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Società Italiana Gallerie  
Italian Tunnelling Society



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