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Tunnels Emergency Planning Methodology and Challenges

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ORDEM
DOS
ENGENHEIROS



Società Italiana Gallerie
Italian Tunnelling Society



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

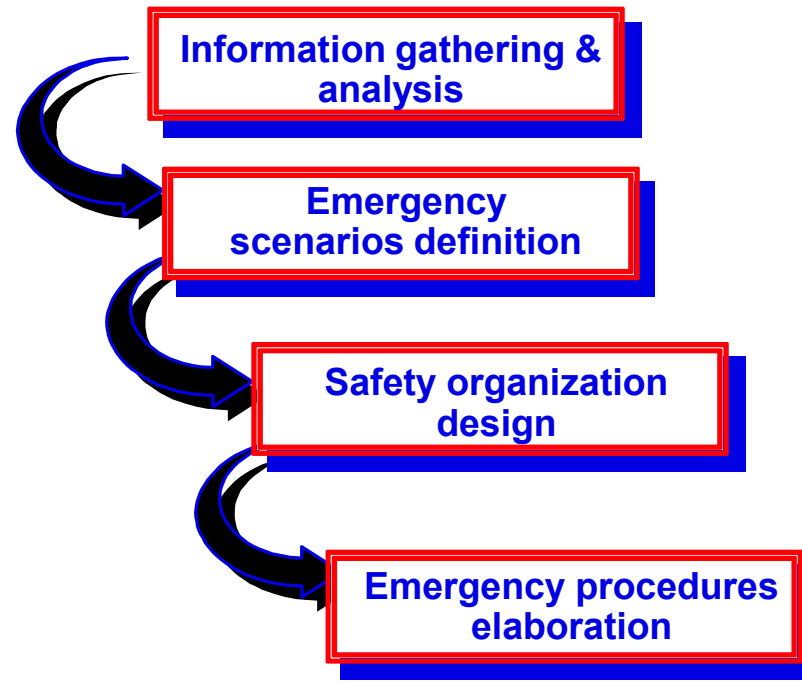
Tunnel Emergency Plan - Objectives

To provide **tunnel user's safety** it is necessary that **Tunnel Operating Body** organize its staff in order to:

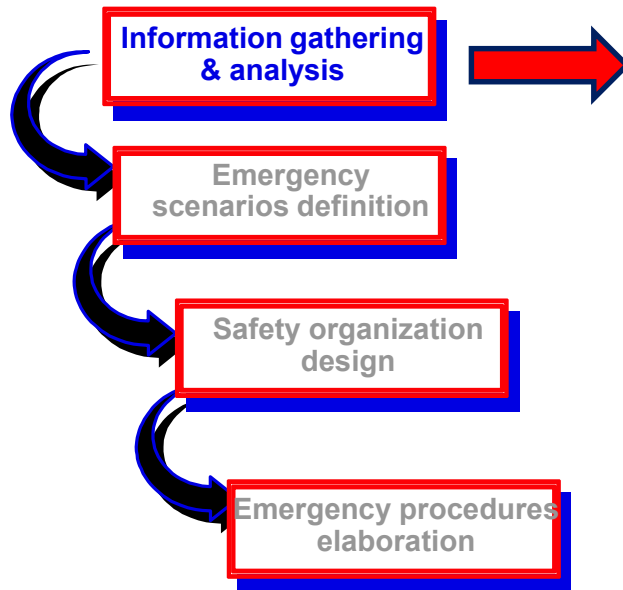
- > **Identify** the various situations that can affect tunnel user's safety;
- > Perform the **adequate actions** to life prevention and protection, attending to the threats related with each identified situation.

Methodology

To develop a Tunnel Emergency Plan it is needed to adopt a specific methodology, as exemplified:

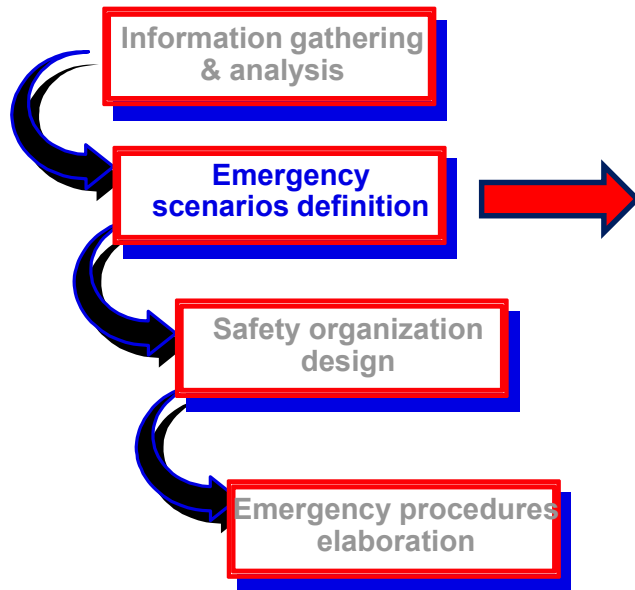


Methodology - Information gathering & analysis



- Risk analysis;
- Tunnel monitoring/alarm & communication systems;
- Tunnel other safety systems and equipment;
- Tunnel operating conditions and staff assigned to the operation.

Methodology - Scenarios definition



It is important to consider two levels of scenarios, depending on their severity:

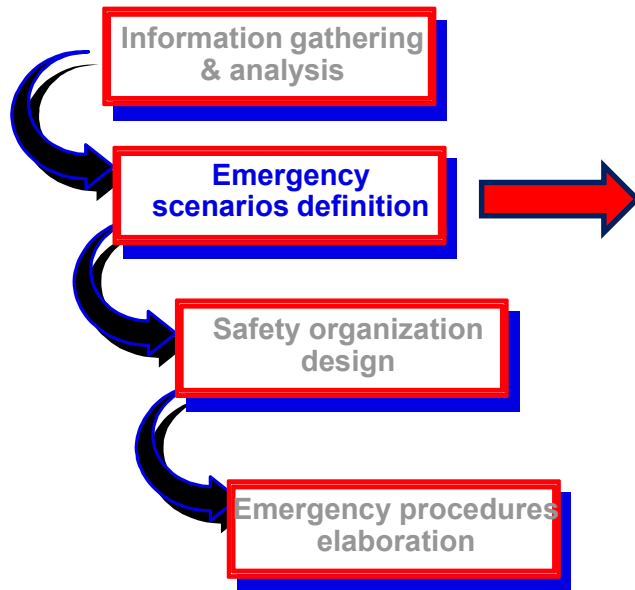
1. Lower severity level

Events/incidents without casualties and **without immediate danger** to tunnel users;

The response will involve **tunnel staff** and, in certain situations, may involve public emergency services;

The response may involve preventive actions or partial restrictions in circulation, but **no tunnel closure**.

Methodology - Scenarios definition



It is important to consider two levels of scenarios depending on their severity:

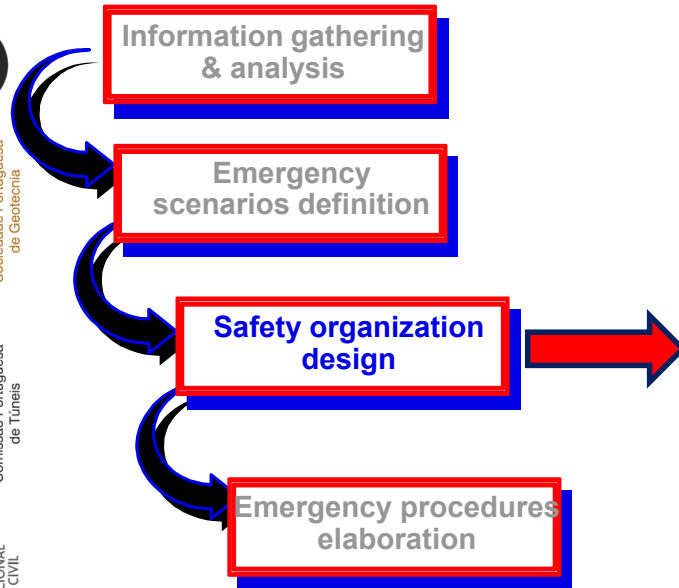
2. Higher severity level

Emergency scenarios with victims or potential victims;

The response will involve **tunnel staff** and **external emergency services**.

The response will involve the **closure of the tunnel**.

Methodology – Safety organization

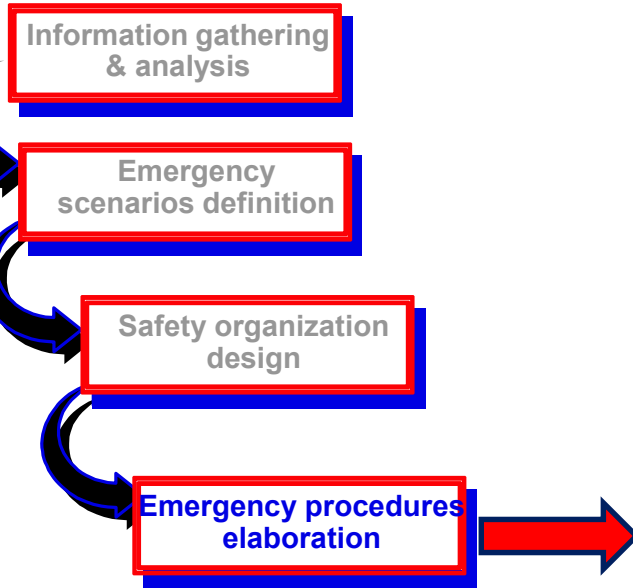


Tunnel Operating Body internal services:

- Tunnel operator staff;
- Duty manager;
- Patrols;
- 1st responders;
- Maintenance services;
-

Responsibilities & Roles

Methodology – Emergency procedures



Some examples of emergency procedures content:

- Immediate actions on tunnel systems and equipment;
- Call out the internal services;
- Alert external emergency services;
- In depth size up & incident evaluation;
- External emergency services support;
- Post incident recovery;
- ...

Tunnel Emergency Plan - Content

Examples of Tunnel Emergency Plan Content:

- > Document management;
- > Tunnel characteristics (brief - safety related);
- > Tunnel emergency organization;
- > Emergency scenarios;
- > Emergency procedures (during scenario's lifecycle);
- > Preparedness methods and needs;
- > Logging methods.

Tunnel Emergency Plan - Content

Safety related tunnel characteristics – examples:

- Internal monitoring and alarm systems;
- Ventilation systems;
- Egress conditions;
- Public address and other systems to communicate with tunnel users, specially those needed to support evacuation strategy;
- Communications systems to support alert and emergency command and control;
- Systems to provide traffic control and tunnel closure;
- Fire fighting systems and equipment;
- ...

Tunnel Emergency Plan - Content

Tunnel resources emergency organization:

- > Tunnel Operating Body chain of command, internal team design and capability;
- > Tunnel staff roles and responsibilities;
- > Alert methods including event coding;
- > Evacuation coordination and support resources;
- > Traffic management strategy related with the emergency scenarios;
- > Interaction between tunnel internal team and external emergency services;
- > ...

Emergency Plan Success - Key success factors

- > **Tunnel Operating Body commitment;**
- > Sustainability of safe operating conditions, (including infrastructure maintenance);
- > Tunnel staff training;
- > Tunnel staff and external emergency services cooperation;
- > Emergency exercises (CPX & LIVEX);
- > Emergency Plan continuous evaluation (dynamics);
- > **Tunnel user's safety awareness.**

To support Emergency Plan's operationality

Preparedness actions:

- > Tunnel staff training program;
- > Emergency exercises program;
- > Users safety awareness program.
- > Effective monitoring of tunnel operation;
- > Safe operation and maintenance policy;
- > ...

To support Emergency Plan's operationality

Document and other support needed to emergency operations success:

- > Tunnel operation manual;
- > Emergency situations event logging (analysis and lessons learned);
- > Emergency exercises logging (lessons learned);
- > ...

Tunnel Emergency Plan – Facts of life

Engineering/Technology is important

But

Human factor is much more important.
People make the real difference (also) in an
emergency.

Tunnel Emergency Plan – Main challenges

> Human factor related

- Tunnel user's awareness
- Tunnel Operating Body preparedness
- Public emergency services preparedness

> Time related

- Response time improvement
- Change management in accordance with dynamic risk

Tunnels Emergency Planning Methodology and Challenges

Thank you

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