

New tunnel safety standards in Italy

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Rescue Operations in Underground Facilities

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The current Italian legislation on fire safety in the subways is the Decree of the Ministry of Transportation January 11, 1988 "**Regulations for the prevention of fires in the subway**"

Recently, a study has been promoted to update the decree in order to take into account new needs and new opportunities such as:

- growing traffic volumes
- integration with other activities such as shopping malls, rail interchanges, car parks, new technologies (eg automatic guidance systems)
- new design approach, which is often based on modeling (eg, patterns of development and propagation of fire, occupants escape, etc.

a Working Group of the Higher Council of Public Works, has prepared the draft standard "Basic requirements for the Underground"

The draft standard is at the moment under final approval



Main innovations introduced by the draft legislation

Measures to:

- Prevent accidents
- Mitigate consequences of incidents
- Facilitate rescue operations



Prevention measures

- Systems controlling the pedestrian lane crowding
- Prevention systems against the possible pedestrian lane collapse
- CCTV video surveillance and alarm systems of the runways



Prevention measures



Control Systems against crowding

In order to avoid overcrowding, appropriate monitoring system must be provided. The system must warn the achievement of the maximum crowding possible.

When the crowds on the platform exceed for unforeseen events, the maximum possible value for a safe intervention, it will be necessary to restrict the access flow on the dock.

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Prevention measures



Obstacle detection on the runway
Risk of falling from the dock

Protection Systems

If the installations/facilities are completely automatic and are not man-controlled, systems detecting the presence of obstacles on the runway should be provided. The systems run also in the case of driver on board and, during highly crowded periods, the overcoming of the safety yellow line should be warned.



Prevention measures - CCTV surveillance systems

Surveillance system and intrusion detection

Remote control with CCTV systems. The data are sent to the emergency room of the facility company, to the emergency responsible of that station and to the institutional bodies (Firefighters, Police, Health Service)

The CCTV system must ensure the display and record of images even in the presence of environmental haze caused by smoke of fires. The system must be protected from vandalism and from the effects of heat generated by fire.



Mitigation of the consequences of an accident

- Safe Escape
- Passive Fire Protection
- Active Fire Protection



Mitigation of the consequences of an accident

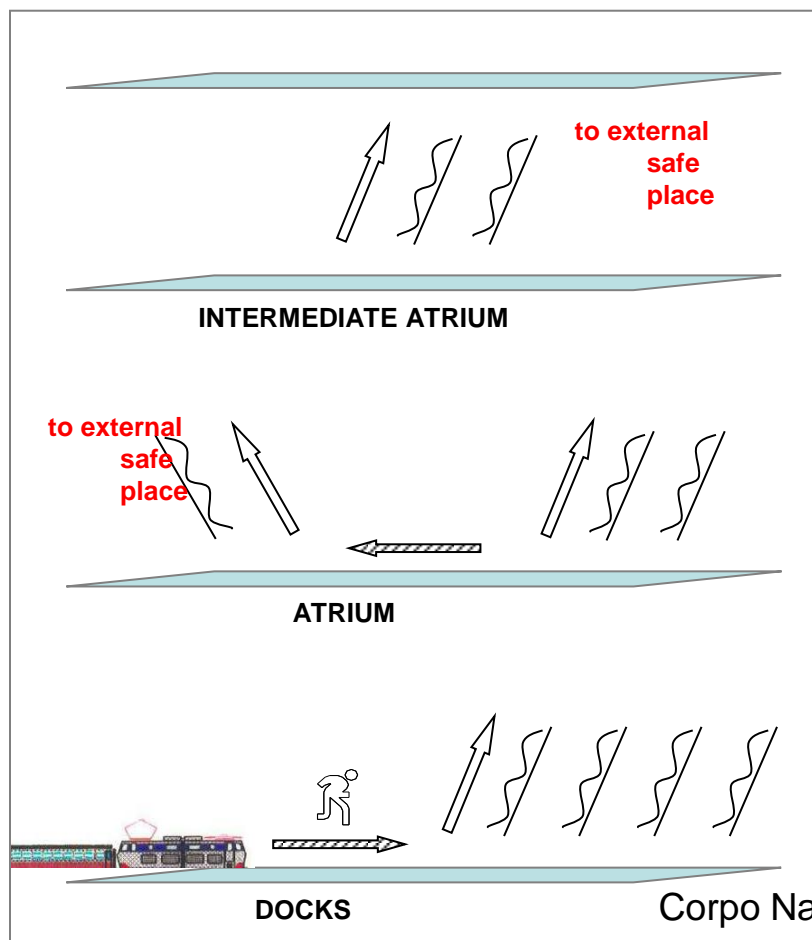
Escape safety

- Approach based also on evacuation times
- Rescue areas near the docks to collect people in difficulties (for height differences between dock and exit plane > 6m)
- Reversing the direction of escalators (0.5 m / s - 0.7 m / s)
- Line of access control - turnstiles



Safe escape from underground stations

MEANS OF ESCAPE



FIRST METHOD

Checking the dimensional requirements of the infrastructure related to:
the number of modules to calculate the flow capacity of the escape routes.
(DM 11/1/1988)

SECOND METHOD

Checking the needed time for escaping from the dock to and reaching a safe place
(evacuation platforms: 4 ', evacuation, achieving a dynamic safe place 6 ')



Incidents mitigation



Safe Areas

In stations where the escape route from the dock level to the ground where exit to open space are located, involves a vertical difference of more than 6 m, there should be a safe area near the dock, at a height not exceeding 6 m, having a surface of at least 10% of the platform, and not less than 20 m²; in the case of a round-shaped dock that area shall be reduced by 50%.



Rome Underground – Vittorio Emanuele Stop 17/10/2006

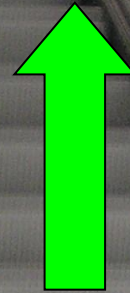
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Incidents mitigation

Reversing escalators direction



Even the escalators, which are normally used to reach the ground level, can be used for the evacuation by reversing the direction or stopping the motion, either automatically as a result of the automatic fire detection system, or manually through the emergency controls placed upstream and downstream the escalator. The command to reverse the direction of travel should be repeated at the emergency room of the station and of the line.

The motion of reversing the direction should proceed slowly, first toward the stop and then towards the opposite direction in order to avoid falling of passengers. The operation of inversion must be indicated by an optical-acoustic device and by a loudspeaker recorded message automatically activated during the operation.

Incidents mitigation

Access control line - turnstiles

The gates and turnstiles located along the escape routes should be opened, during an emergency situation, towards the exit, to ensure people escaping. The opening of the system should occur also in absence of electricity through a remotized emergency room command; the system should also be provided with an automatic fire detection and alarm device. The openings within the access lines to be taken into account for escaping, must be multiples of 0.60 m, including at least an opening of 1.20 m for rescue operations.

Mitigation of incident consequences

Passive fire protection

Dividing into sections the dock: wall for smoke containment

Dividing into sections the dock - sub-vertical_escape routes

: air/water blade; doors in each section of the dock

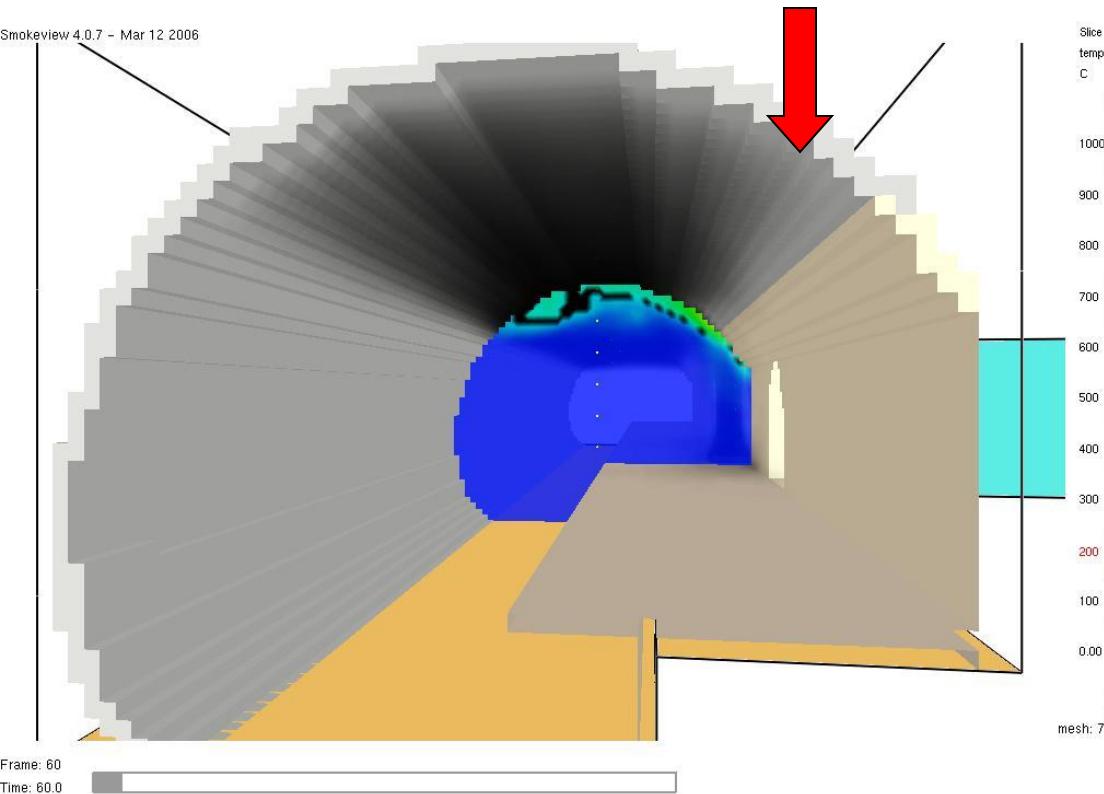
Connection with other transport facilities (railway stations, airports, etc ...) through smoke tested_filters

Connection with intersection parking areas through smoke tested filters



Wall for Smoke Containment

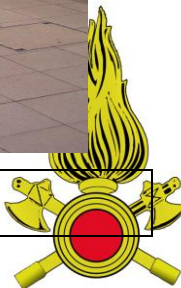
On the platform, at not less than 50 cm from the vertical plane passing through the edge of the ceiling, a vertical wall for smoke containment must be placed, of at least 2.20 m from the dock ground .The curtain shall have fire resistance not less than 60 REI



Manzoni Simulation

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Frankfurt Underground

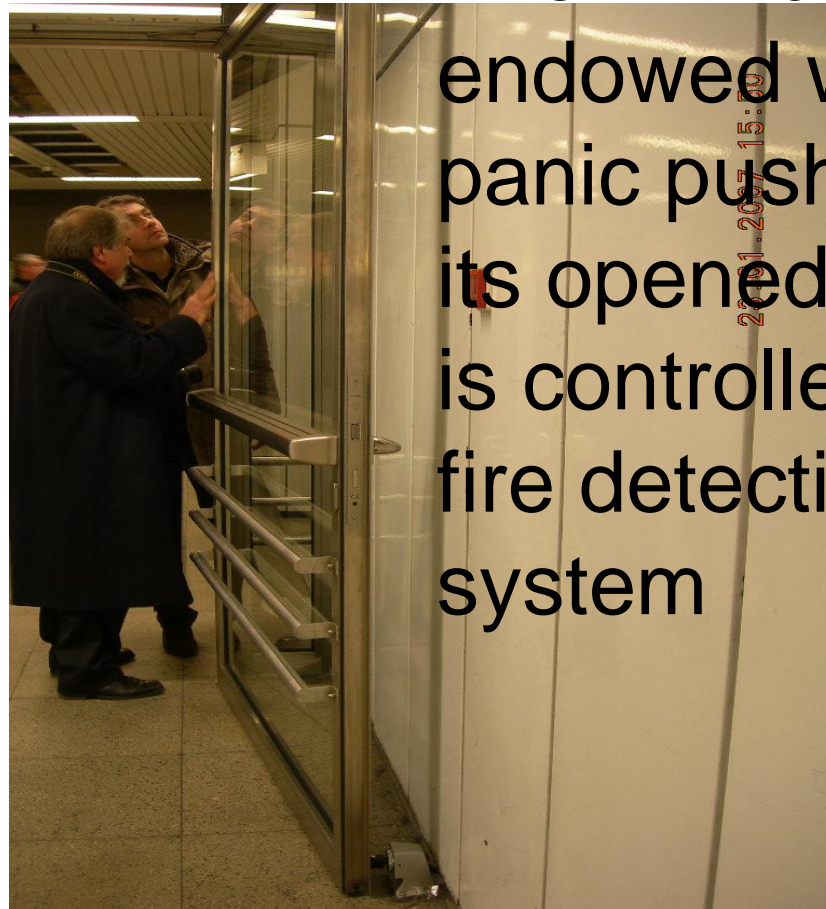


Fire doors



(Frankfurt Underground)

- The REI door is endowed with a panic push-bar and its opened position is controlled by the fire detection system



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Activities allowed in stations



Small premises

(bar, small shops, offices etc.).

Direct access inside the station if the surface of each shop is less than 200 m² and the total surface is not higher than 600 mq, including services and stores

Shopping centre and transport company offices

- Direct access from outside the station
- Connection with the station through smoke tested filter in the case of offices with no more than 50 people having a surface for each section up to a maximum of 1500 mq or in cases of shopping centers having a surface for each section up to a maximum of 2000 mq



Mitigation of incident consequences

Active fire protection

Ventilation and smoke/heat extraction devices

Air/water blades at the gates between the dock and sub-vertical routes

Cooling water installations:

directed on arriving gates (jet spray deluge)

shops and stores

escalators

Automatic fire detection and fire alarms devices to protect all the areas of the station



Protected Escape Routes

AIR BLADE

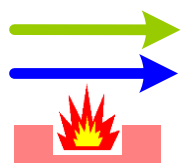
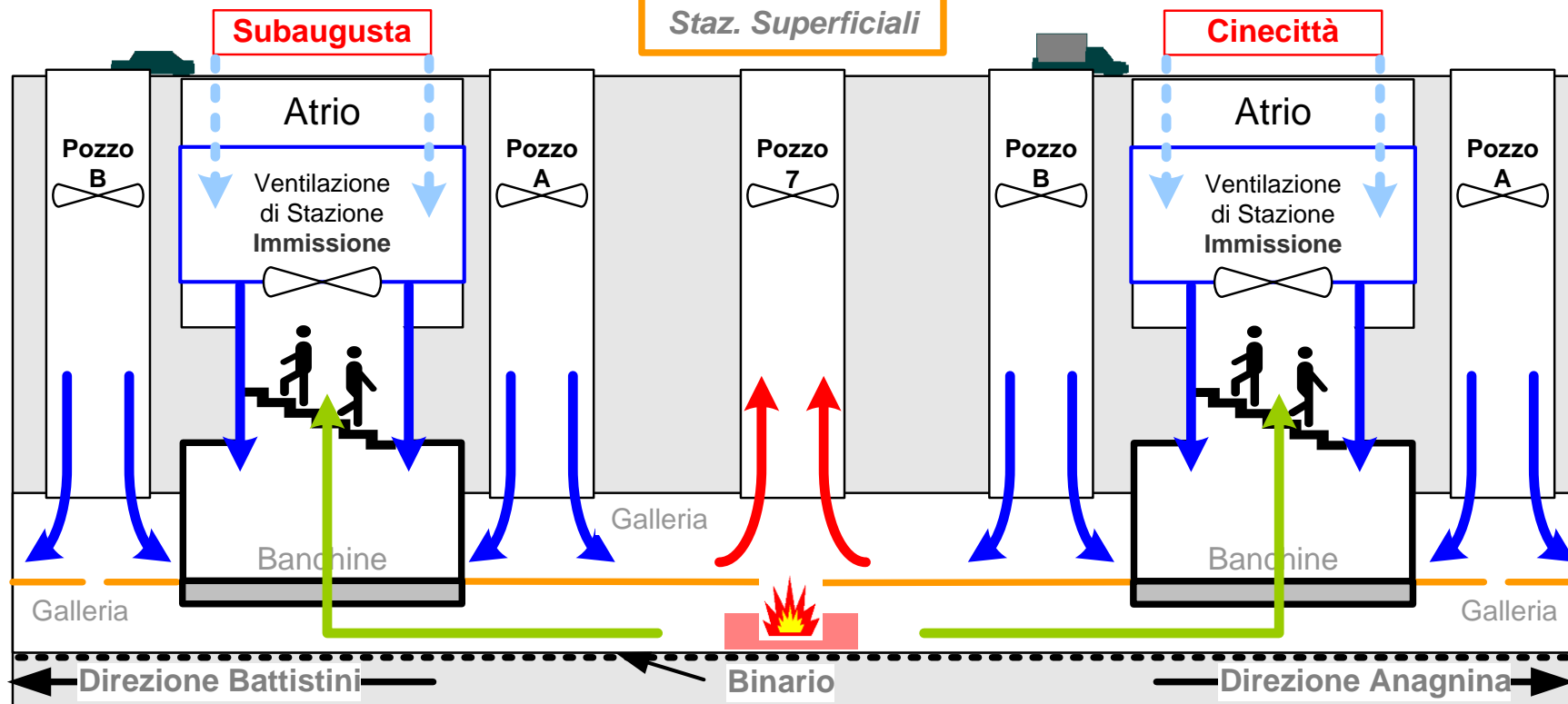
Underground stations shall be provided with natural ventilation systems, forced and emergency ones

The subways shall be equipped with emergency forced ventilation systems located in stations and tunnels, working in a coordinated way and controlled by a remote center.

The plant must have the possibility of reversing the direction of air motion (input and output).

The operation of the extraction of smoke and hot gases must be combined with the activation of the air walls provided at the station.

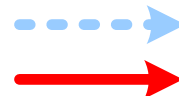
Schema n° 8
Staz. Superficiali



VIA DI FUGA

ARIA FRESCA a circolazione FORZATA

Zona in emergenza incendio



ARIA FRESCA a circolazione NATURALE

ARIA CALDA E FUMI

Cavo termosensibile

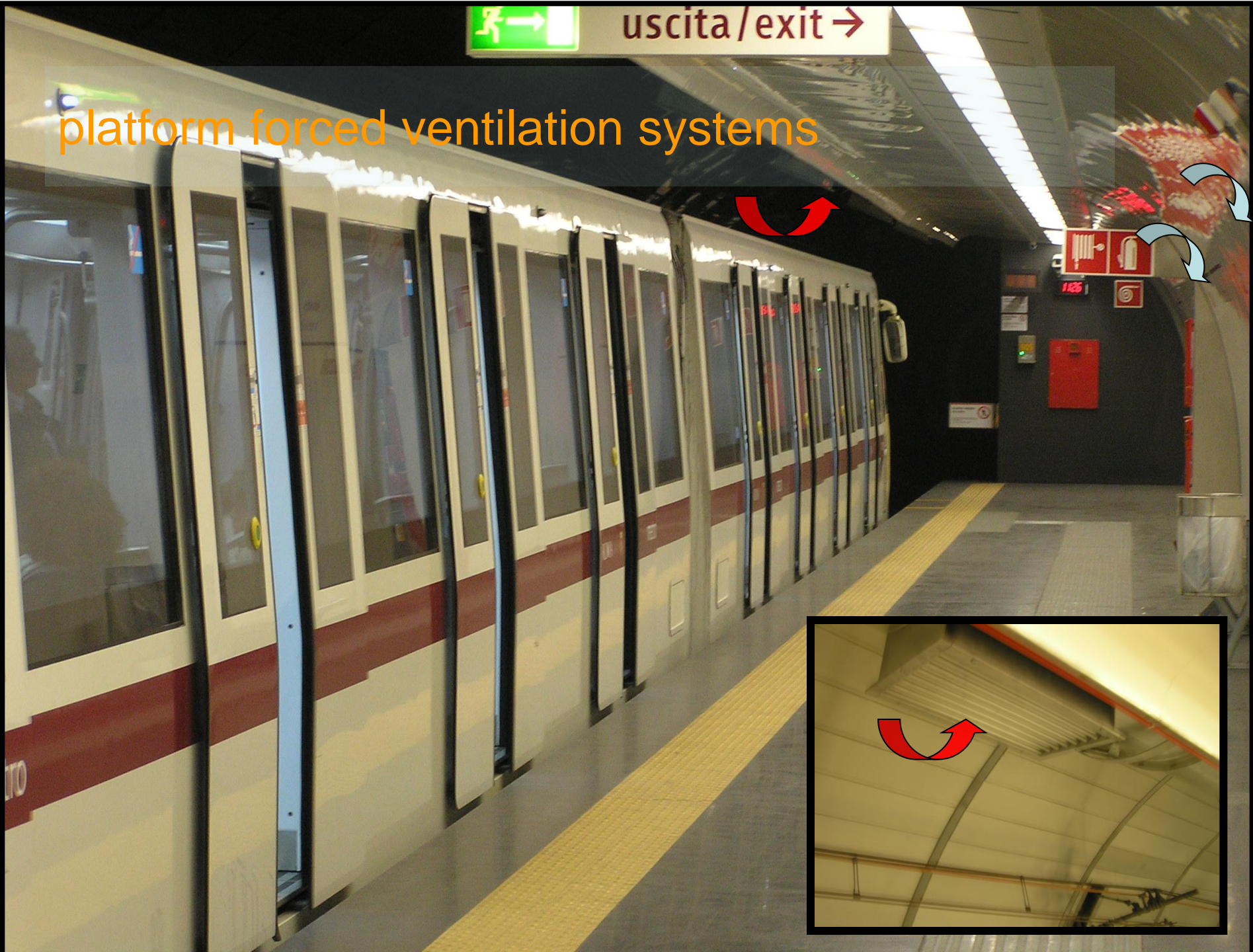
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uscita / exit →

platform forced ventilation systems



Train cooling system



Train cooling system
Located along the whole platform
with a water spray jet installed
and directed towards the exit
doors



Facilitating Rescue Operations

- Accessibility to the station area – ground floor
- Accessibility to the tunnel
- Accessibility for special robotized fire vehicles to the station and to the line
- Rescue Areas for injured persons- width of the escape routes (route 1,80 m –rest areas 2,40 m for transporting stretchers)
- Motorized system for transporting victims



Facilitating Rescue Operations

- **Rescue equipment in the station** (stretchers, drills, trucks for material handling / injured persons)
- **Rescue Elevator** (difference between dock level and exit > 12 m)
- **Emergency planning** (internal and external)
- **Simulations**



Accessibility to the Station Area



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Facilitating Rescue Operations

Accessibility to the Station Area



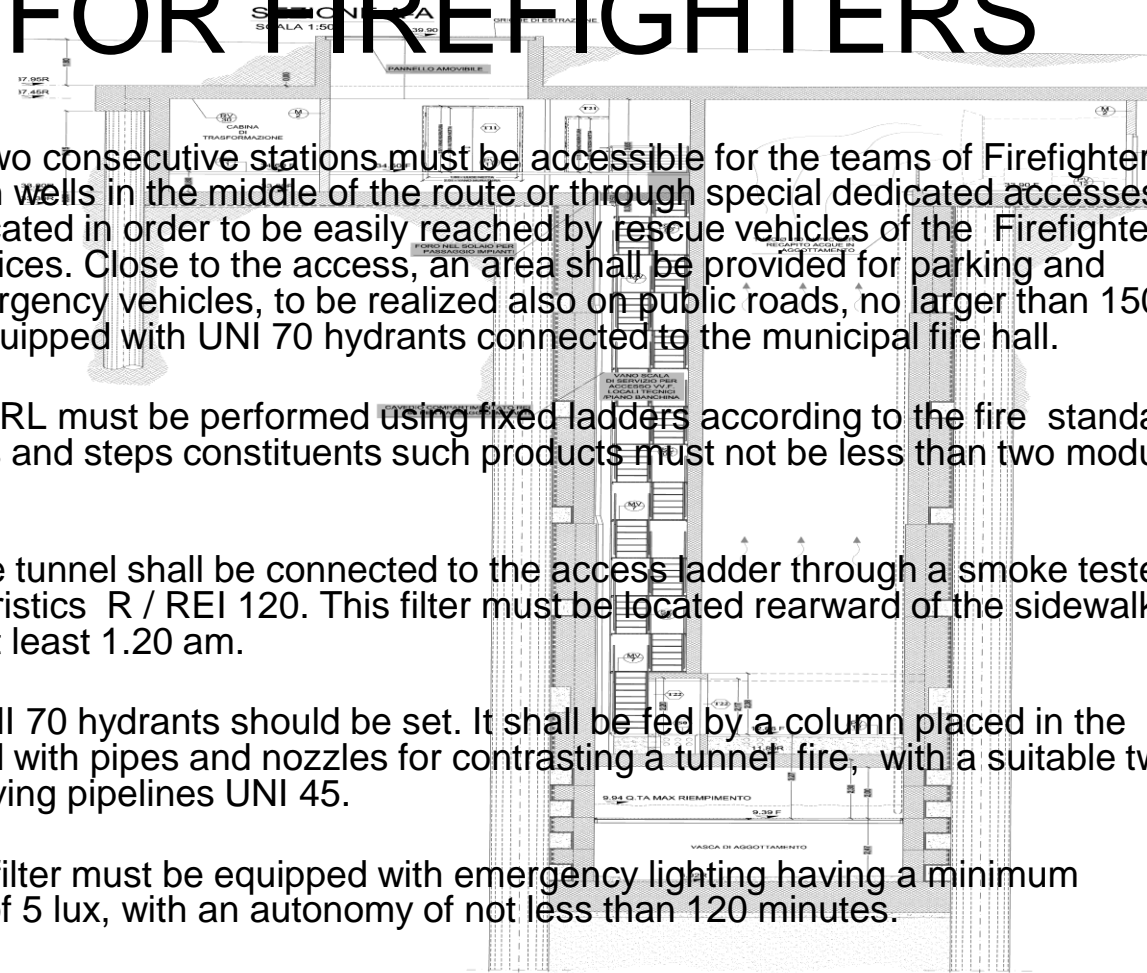
Rome underground incident – Vittorio Emanuele, 17/10/2006

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In order to allow rescue operations, stations must be located near widening of roads, squares or areas that allow the storage of emergency vehicles and the positioning of medical triage areas, advanced medical points and the use of emergency equipment. These areas should be pedestrian, connected with the ordinary roads system, adjacent to the stations and at the same level of their entrance. They should have an area of no less than 500 square meters and should be constantly maintained practicable and usable for emergency crews. The maintenance of the conditions of usability should be prescribed by specific signs.



ACCESSIBILITY TO THE TUNNEL FOR FIREFIGHTERS



- The tunnel between two consecutive stations must be accessible for the teams of Firefighters through the ventilation wells in the middle of the route or through special dedicated accesses. The entrances must be located in order to be easily reached by rescue vehicles of the Firefighters and other emergency services. Close to the access, an area shall be provided for parking and maneuvering the emergency vehicles, to be realized also on public roads, no larger than 150 square meters and equipped with UNI 70 hydrants connected to the municipal fire hall.
- Connection with the ARL must be performed using fixed ladders according to the fire standards. The width of the stairs and steps constituents such products must not be less than two modules (1.20 m).
- The arrival point in the tunnel shall be connected to the access ladder through a smoke tested filter having characteristics R / REI 120. This filter must be located rearward of the sidewalk in the gallery space of at least 1.20 am.
- Inside the filter, an UNI 70 hydrants should be set. It shall be fed by a column placed in the descendery, equipped with pipes and nozzles for contrasting a tunnel fire, with a suitable two-ways distributor for laying pipelines UNI 45.
- The stairwell and the filter must be equipped with emergency lighting having a minimum illumination capacity of 5 lux, with an autonomy of not less than 120 minutes.
- Inside the filter or its access path, the devices for the interruption of engine power of the convoys must be duplicated. A cabinet containing n. Flowers 4 to short-circuit the contact lines and n. 4 stretchers on the spine board must be located



Handling of the injured persons: critical aspects



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Handling the stretchers



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Handling the stretchers

If the access to the dock level needs the use of fixed stairs or escalator with a vertical drop of more than 7 meters, an emergency system shall be provided in order to handle the stretchers or other materials between the two different levels of the facility



Measures to facilitate rescue operations - Accessibility for special robotized fire equipment to be used in tunnels and station

Appropriate solutions should be identified in order to ensure accessibility for special robotized rescue vehicles, both from the road level to the dock level and by the latter to the ARL. In addition, one or more sections of the subway must be provided with an access for fire fighting vehicles from the road level to the ARL. The distance among these kind of accesses must not exceed the distance between four consecutive stations.

22.01.2007 17:02



**Radio-controlled fire truck of the italian
firefighters' organization
Mechanical ventilation (90,000 m³ / h)
Water supply at high speed (3000 l /
min)
Fighting foam Supply (800 l / min)**





CIPRO

CIPRO

Rechner's

UF 65

FEUERWEHR



PRO

FEUERWEHR

Rechner's

Measures to facilitate rescue operations - rescue equipment



Trolley for transporting rescue equipment on the line



Rescue Sheets



Corp

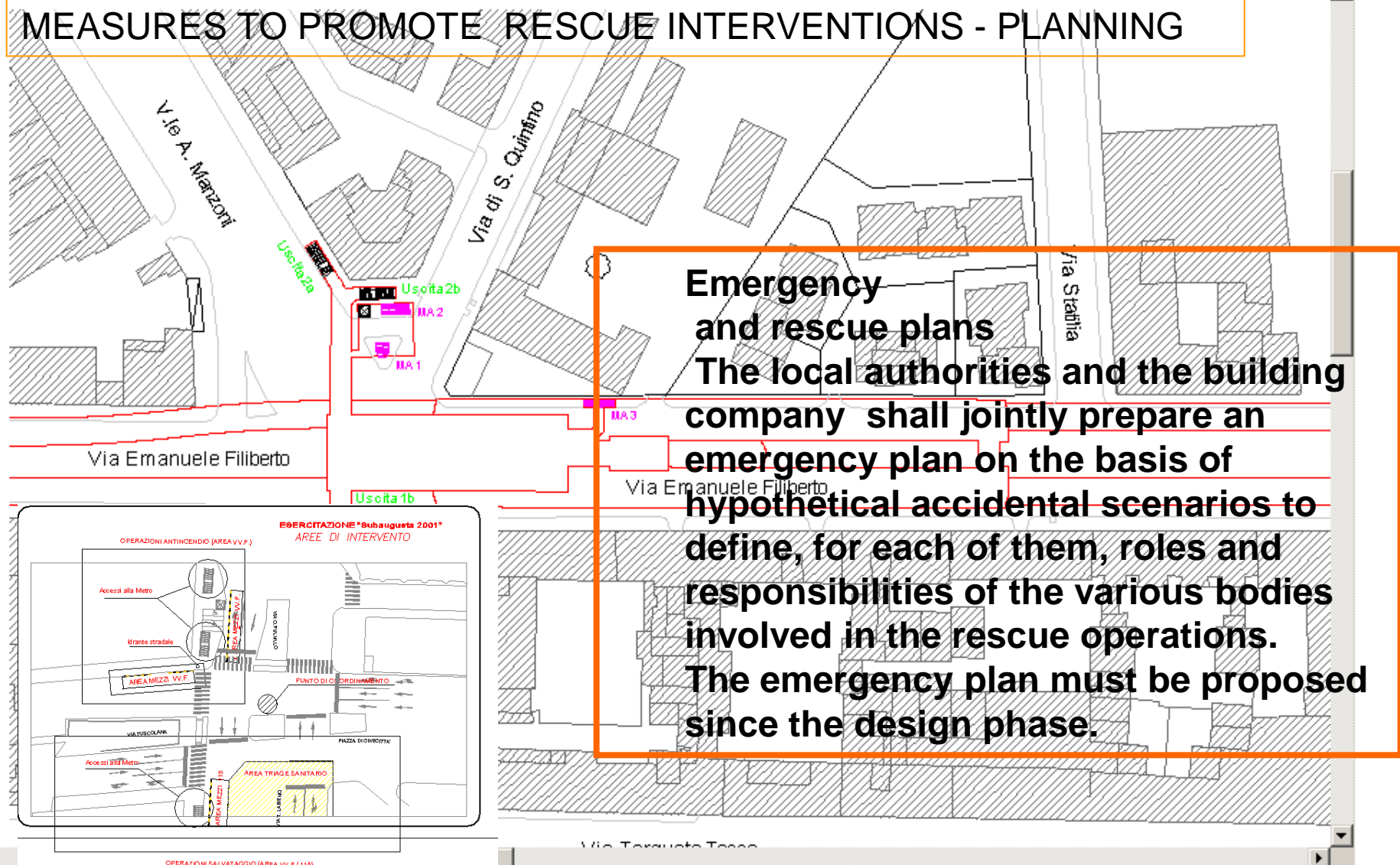
COMMUNICATION DOCK-ENTRANCE AND RADIO SYSTEM

Telecommunications system

It must be a system that allows radio communication, in all the areas of the facility, for the staff on the trains and between it and the control center. A similar system should ensure communications for the bodies competent for accidents prevention.



MEASURES TO PROMOTE RESCUE INTERVENTIONS - PLANNING



Regular simulations with the rescue teams

Emergency systems and devices should be periodically checked by the company in order to be used in any case of emergency

Joint simulations both with the company staff and the rescue teams must be carried out, to ensure appropriate training to collaboration, communication and coordination during a possible emergency.



Thank you for your attention

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