



# **FIRE SAFETY IN COMPLEX UNDERGROUND TRANSPORT INFRASTRUCTURES**

Arnaud MARCHAIS

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## **RATP underground networks in PARIS**

- 110 years of exploitation of the Paris Metro**
- 40 years of exploitation of the RER line A and B**

# **Fire safety in complex underground transport infrastructures**

- **RATP Networks Presentation**
- **Fire safety policy : why ?**
- **Fire safety policy : which one**
- **RATP answers**
- **Conclusion**

# Fire safety in complex underground transport infrastructures

## Identity card

- Public company
- Created by the law of March 21, 1948
- Subject: Regional Mass Public transit in the greater Paris area
- 42000 work force

**RATP is a public transport operator**

# Fire safety in complex underground transport infrastructures

## RATP Networks Presentation

### A- Infrastructures

- Subway: 16 lines
  - 200 km of lines including more than 180 underground
  - 372 stations including 343 underground
- Heavy Metro network (the RER): 2 lines
  - 100 km of lines with 30 underground
  - 66 stations including 12 underground

# Fire safety in complex underground transport infrastructures

## RATP Networks Presentation

### A- Infrastructures

- Electric fan: more than 320
- Air shaft : more than 360
- Escalator : more than 600
- Lifts : more than 400

# Fire safety in complex underground transport infrastructures

## RATP Networks Presentation

### A - Infrastructures

- Short tunnels between stations
  - Subway: less than 3000 meters
  - RER: less than 5000 meters

# Fire safety in complex underground transport infrastructures

## RATP Networks Presentation

### A - Infrastructures

- High occupancy of public areas in the stations.
  - The RER: line A more than 1 million travelers/day
  - SUBWAY: lines 1, 14 and 4, each one > 450.000 t./day
  - Châtelet Les Halles : 800.000 travelers per day in the metro and RER areas.

# Fire safety in complex underground transport infrastructures

## RATP Networks Presentation

### B – Rolling Stocks

- High occupancy of the cars:
  - METRO train: 900 passengers
  - RER train: 3300 passengers
- Tunnels, short time between station:
  - Subway: less than 90 seconds
  - RER: less than 300 seconds

# Fire safety in complex underground transport infrastructures

## RATP Networks Presentation

### B – Rolling Stocks

- High frequency of traffic:
  - 1320 departures of trains during peak hours
- High density of network occupancy
  - 721 trains running at the same time
- Daily ridership: more than 6,6 millions trips per day

# Fire safety in complex underground transport infrastructures

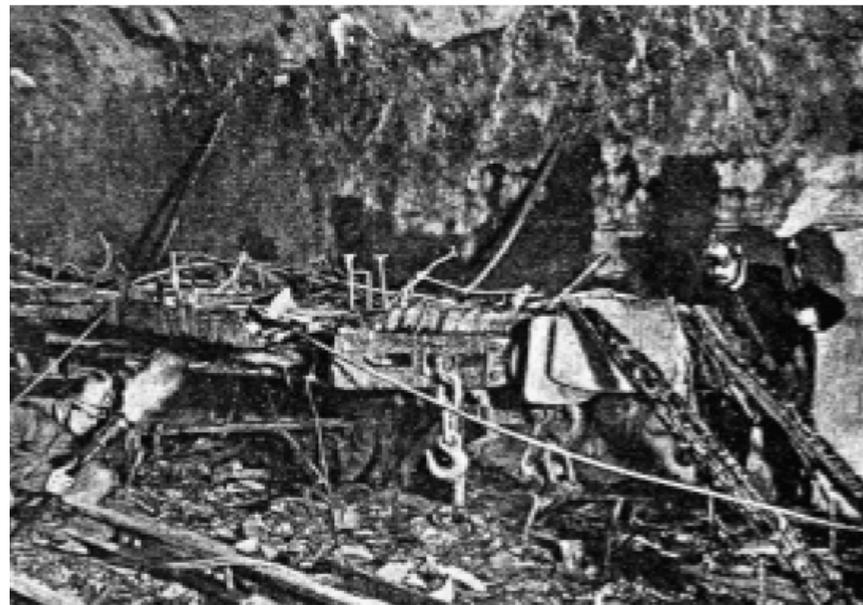
## Fire safety policy : why?

- **Couronnes**
- **Vincennes**
- **Nanterre**
- **Simplon**

# Fire safety in complex underground transport infrastructures

## Fire safety policy : why?

- **Couronnes 1903**



*Train fire in Couronnes station (1903)*

- fire in a rolling stock, 84 fatalities in an underground station

# Fire safety in complex underground transport infrastructures

## Fire safety policy : why?

- **Vincennes 1975**



- No victim, six cars in two trains were destroyed

# Fire safety in complex underground transport infrastructures

## Fire safety policy : why?

- **Nanterre 1985**



- No victim, one car was destroyed

# Fire safety in complex underground transport infrastructures

## Fire safety policy : why?

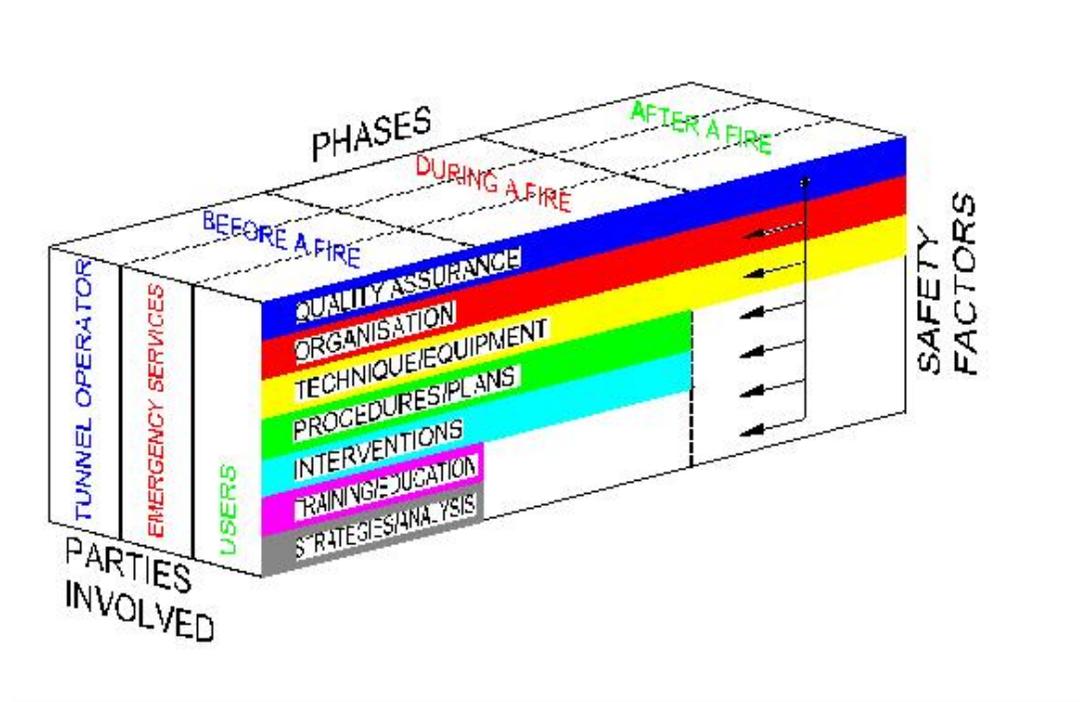
- **Simplon 2005**



- No victim, two cars in two trains were involved

# Fire safety in complex underground transport infrastructures

## Fire safety policy : which one



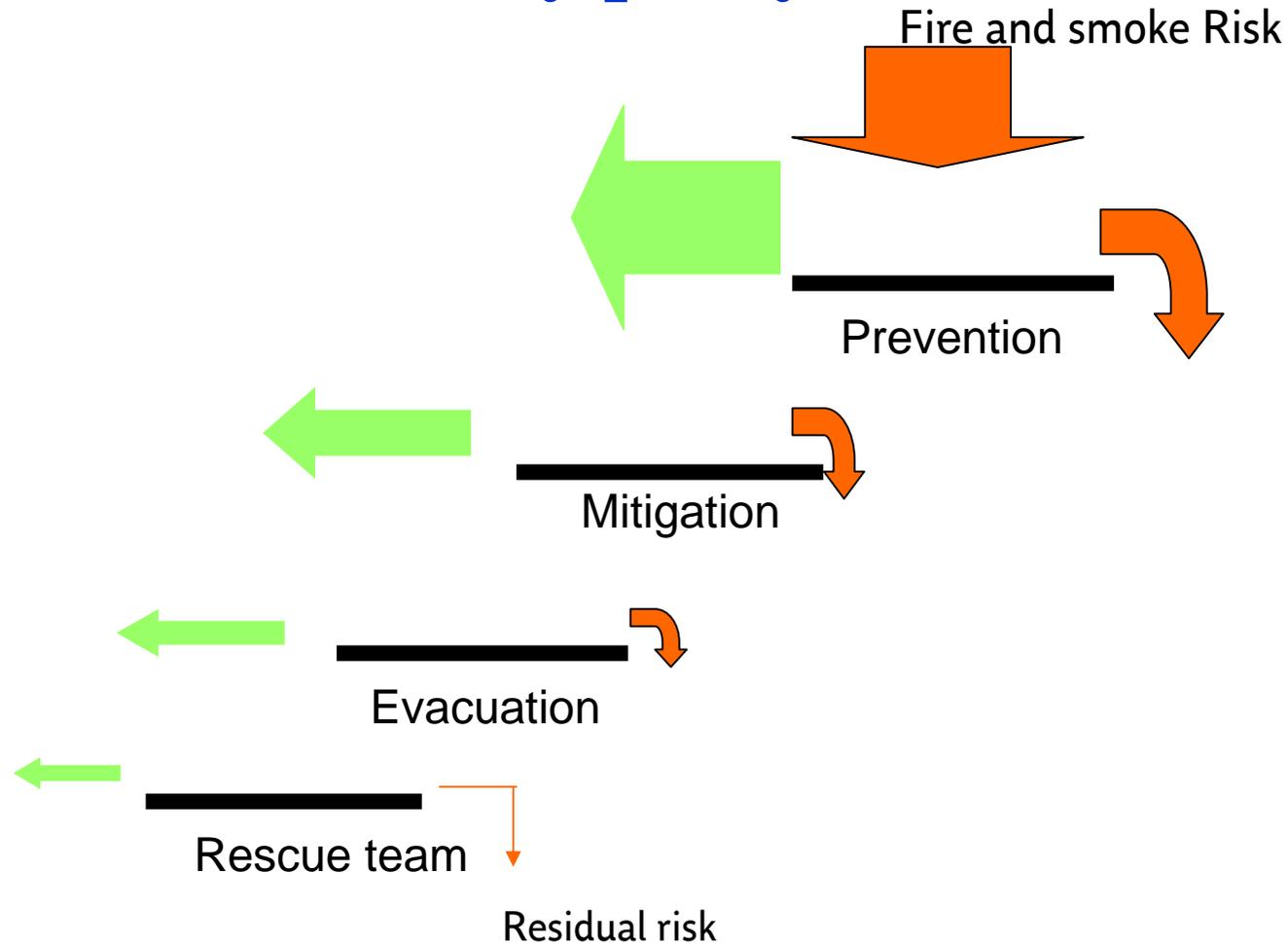
# Fire safety in complex underground transport infrastructures

## Fire safety policy : which one

- Lessons learned integration
- Risk Prevention
- Users evacuation

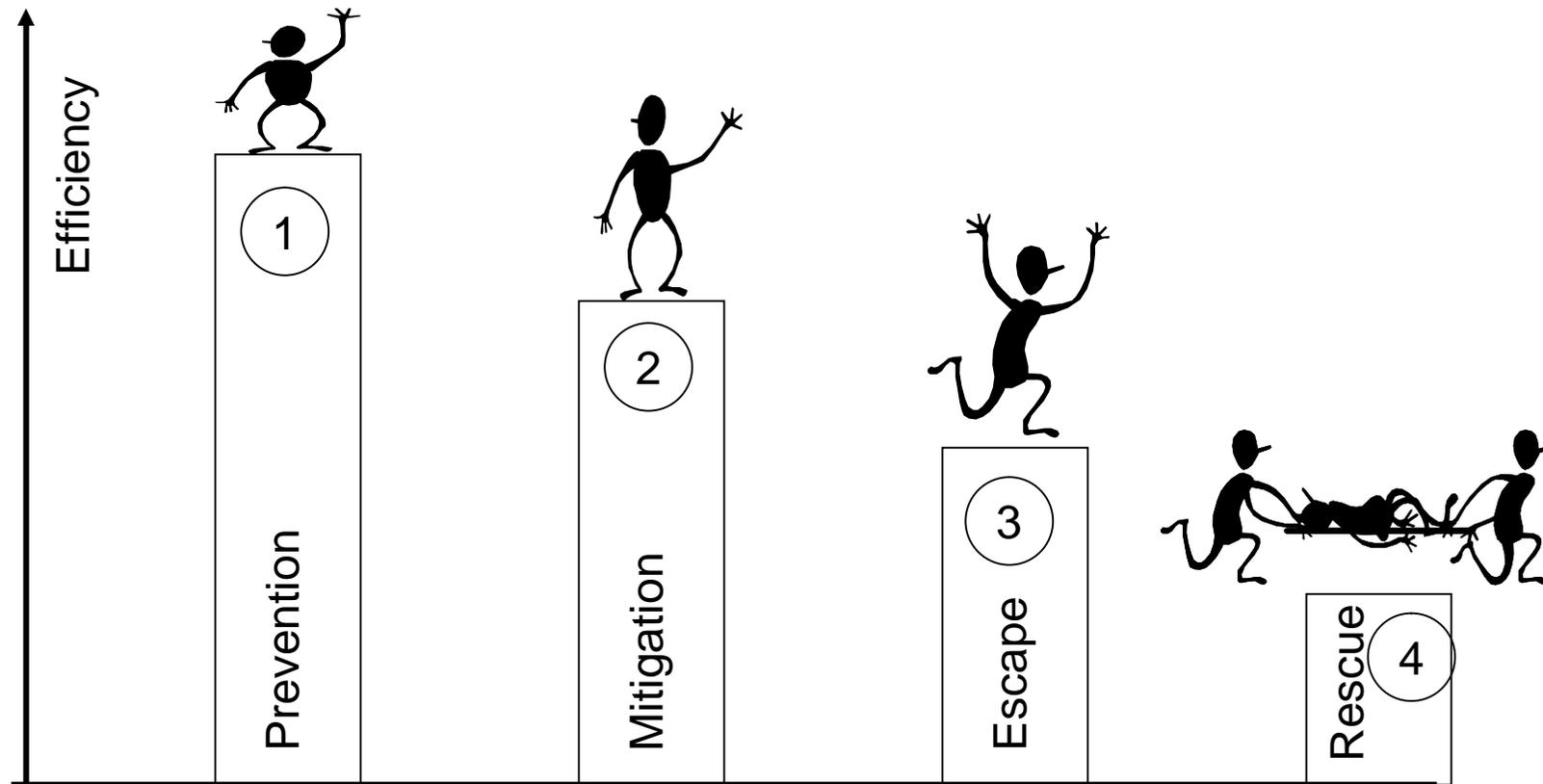
# Fire safety in complex underground transport infrastructures

## Fire safety policy : which one



# Fire safety in complex underground transport infrastructures

## Fire safety policy : which one



# Fire safety in complex underground transport infrastructures

## RATP answers

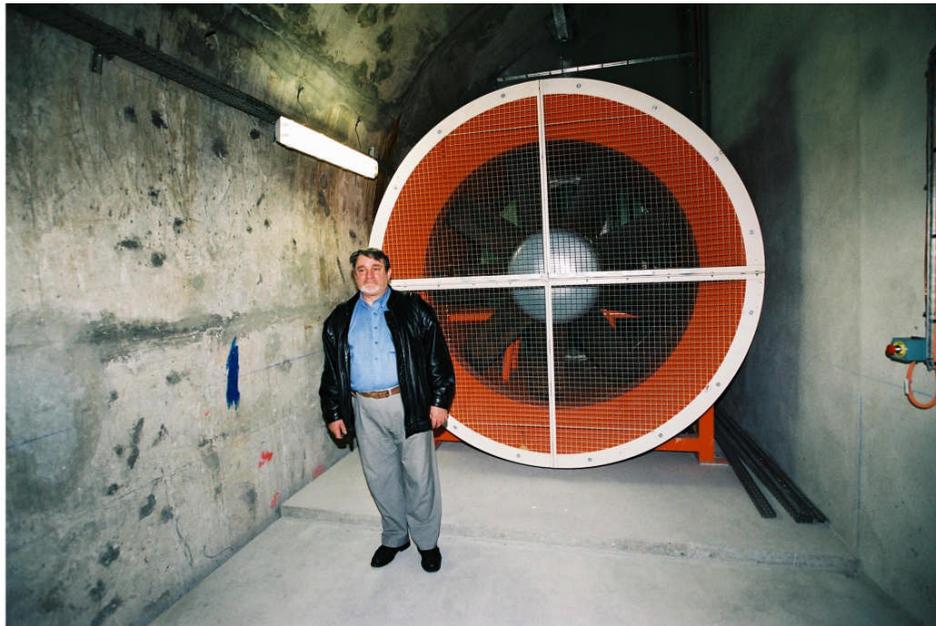
### Prevention

Fire behaviour of materials and components	Fire Resistance requirements for fire barriers	Fire safety requirements for Rolling Stock and underground station design	Fire safety requirements for Electrical equipment	Fire control and management system	Fire safety requirements for Flammable liquid and flammable gas installation
Prevention = “transverse” state of mind					

# Fire safety in complex underground transport infrastructures

## RATP answers

### Mitigation



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# Fire safety in complex underground transport infrastructures

## RATP answers

### Evacuation

- Handrail and escape signage



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# Fire safety in complex underground transport infrastructures

## RATP answers

### Rescue Team



# Fire safety in complex underground transport infrastructures

## RATP answers

- **Couronnes**

- Prevention
- Fire safety requirements for electrical equipment
- Fire behaviour of materials and components

# Fire safety in complex underground transport infrastructures

## RATP answers

### •Vincennes

- Tacking into account smoke fumes and toxicity of the materials
- Improvement of lighting in rolling stock.
- Implementation of a smoke evacuation policy

# Fire safety in complex underground transport infrastructures

## RATP answers

### •Nanterre

- Improvements of RER R.S. using of French Standard, (NFF 16-101, 16-102, 16-103)
- Upgrading of passenger area taking into account smoke fumes and toxicity of the materials
- Improvement of lighting in rolling stock.
- Improvement of seat design

# Fire safety in complex underground transport infrastructures

## RATP answers

- **Simplon**
  - Improvement of the traction line of this subway train
  - Redesign of the ventilation sectors in underground
  - Definition of a new operational protocols responding to fire

# Fire safety in complex underground transport infrastructures

## RATP answers

- **Full scale tests with fires**
- 1985, ignition of an illuminated red baton in passenger area
- 2002, ignition of 0.75 liter of alcohol in passenger area
- 2009, ignition of a trash bag on a corner seat in passenger area
- 2011 Real scale test with fire in passenger area (TRANSFEU project)

# Fire safety in complex underground transport infrastructures

## RATP answers

- **Full scale tests with fires**
- In 1985, ignition of an illuminated red baton in passenger area of RER
- First step in an upgraded passenger area
- Second step in a genuine passenger area

[VIDEO](#) **85**

# Fire safety in complex underground transport infrastructures

## RATP answers

- **Full scale tests with fires**
- 1985, ignition of an illuminated red baton in passenger area of RER, main results :
- First step in an upgraded passenger area
  - No spreading of the fire
  - Destruction of Limited surface of the passenger area
- Second step in a genuine passenger area
  - Very fast spreading of the fire
  - Complete destruction of the passenger area in one car

# Fire safety in complex underground transport infrastructures

## RATP answers

- **Full scale tests with fires**
- 2002, ignition of 0.75 liter of alcohol in the passenger area of a METRO Rolling Stock.

[VIDEO](#) **02**

# Fire safety in complex underground transport infrastructures

## RATP answers

- **Full scale tests with fires**
- 2002, ignition of 0.75 liter of alcohol in the passenger area of a METRO Rolling Stock, main results :
  - No additional heat release from the rolling stock materials
  - No spreading of the fire
  - No destruction in passenger area

# Fire safety in complex underground transport infrastructures

## RATP answers

- **Full scale tests with fires**
- 2009, ignition of a BART trash bag on a corner seat of passenger area.



[VIDEO 09](#)

# Fire safety in complex underground transport infrastructures

## RATP answers

- **Full scale tests with fires**
- 2009, ignition of a trash can on a corner seat of a passenger area.
- Main results :
  - Short and powerful thermal attack
  - No spreading
  - Self-extinguishing



# Fire safety in complex underground transport infrastructures

## RATP answers

- **Full scale tests with fires ( TRANSFEU project )**
- In 2011, ignition of a continuous flaming source on the floor of a passenger area
- Characteristics of the flaming source :
  - Radiant flux of nominal value in the range 20 to 25 kW/m<sup>2</sup>
  - Average heat of 75 kW for a period of 2 min
  - Radiant flux of nominal value in the range 40 to 50 kW/m<sup>2</sup>
  - Average heat of 150 kW for a period of 8 min
  - The thermal attack is done on the same area (0.7 m<sup>2</sup>)

# Fire safety in complex underground transport infrastructures

- **Full scale tests with fire**
- In 2011, continuous flaming source.

•RATP answers



# Fire safety in complex underground transport infrastructures

- Full scale tests with fires
- In 2011, continuous flaming source

•RATP answers



# Fire safety in complex underground transport infrastructures

## Conclusion

- Fire safety in complex underground transport infrastructures, an open ended process which imposes a global approach to satisfy the fire safety requirements of tomorrow and to increase service quality.

# **Fire safety in complex underground transport infrastructures**

## **Conclusion**

**Think global act local**

# **Fire safety in complex underground transport infrastructures**

**Thank you for your attention**