



FIRE SERVICE VIEW ROAD TUNNEL SAFETY

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**FIRE
SERVICE**

RISK ?

**SEATTLE
TANKER
FIRE**

**Is YOUR
tunnel
ready for
THIS?**



BOEING PHOTO

LIPEC - FIRE SERVICE AND TUNNELS

INCIDENT PRIORITIES =

- **L**IFE SAFETY X 4
- **I**NCIDENT STABILIZATION
- **P**ROPERTY CONSERVATION
- **E**NVIRONMENT
- **C**RIME SCENE PRESERVATION

People, Structure, Economy, Credibility



FIRE EXPERIENCE

- ❑ FIRE PREVENTION
- ❑ FIRE EMERGENCIES
- ❑ EMERGENCY MEDICAL
- ❑ RESCUE- Tunnel, High Angle, Water, etc.
- ❑ DANGEROUS GOODS/ HAZ MAT



NIMS - FIRE SERVICE AND TUNNELS

NATIONAL INCIDENT MANAGEMENT SYSTEM

Created by Fire Service

MANDATED BY US FEDERAL LAW

Infrastructure Owner/ operator

Private business

Public agencies

Emergency responders

**Common Terminology, clearly
outline Roles and Responsibilities**

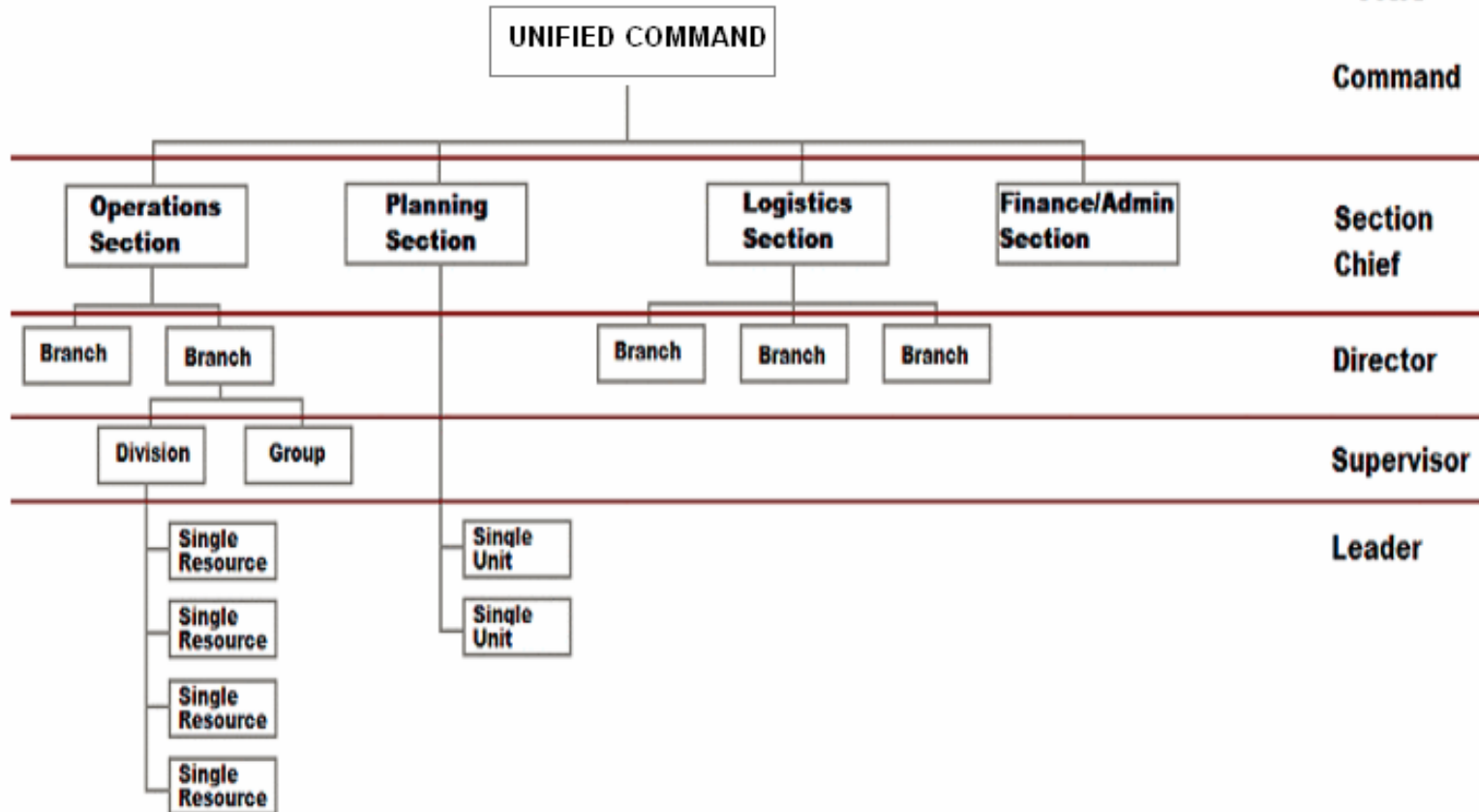
Used for ALL HAZARDS

INTEROPERABILITY ??

Incident Command System

Organizational Chart

Supervisor
Title



ALL HAZARD USE!

FIRE, FLOOD, FAMINE



NIMS and PROBLEM SOLVING

UNIFIED COMMAND brings experts together

EXAMPLE – TUNNEL FIRE

Fire Service - fire / rescue / medical

Tunnel Operator – systems

Tunnel Owner – controls/ costs

Police - traffic, crowd, explosives

Traffic agency - rerouting, signage

- 1. PROBLEM STATEMENTS**
- 2. AGENCY Test / Verify**
- 3. START!**

ONGOING RISK BENEFIT ANALYSIS

UNITED STATES

- ❑ 6.6 million km highways
- ❑ 500+ road tunnels
- ❑ 1,096,900 firefighters
- ❑ 6 Sprinkler Road tunnels in US
- ❑ Of those4 in Seattle

SEATTLE – 5,000 fire sprinkler systems



I-5

DOWNTOWN SEATTLE TRANSIT TUNNEL

2.5 KM

3 underground

Stations

BUS ONLY

2009

Train/Bus



SEATTLE - DSTT Pioneer Sq Station



INTERSTATE 5 - (I-5)



BATTERY STREET TUNNEL – 1952



Interstate freeway (I-90)



I 90 foam pumps



190 foam tanks



Battery Tunnel - TUNNEL VISIBILITY ?



TUNNEL VISIBILITY ? LIGHTING !!!!



SPRINKLERS - FIRE SERVICE AND TUNNELS

SPRINKLER EXPERIENCE

- Slows / stops fire Spread
- Steam NOT a problem
- Visibility SMALL problem

NOT FOR ALL TUNNELS!

Risk vs cost

' Better wet than dead '

BURNLEY FIRE

0 Fire
deaths



NIST (National Institute of Standards & Technology)

CALDECOTT FIRE 1982 (2)

8600 GAL US (32,555 L) Gasoline

Almost **400** MW

950 Degree C (1742 F)

40 minute burn time

6 died

CALDECOTT FIRE - California, 1982

"The heat was so intense coming out of the tunnel no one could get near it, much less attempt to enter,"

"It was the most frustrating experience I had during my fire career, knowing there were people trapped inside there and we could not help them."

- Captain Stan Williams,
- Orinda Fire Dept

OAKLAND TRIBUNE

FIRE SIZE / GROWTH - FIRE SERVICE AND TUNNELS

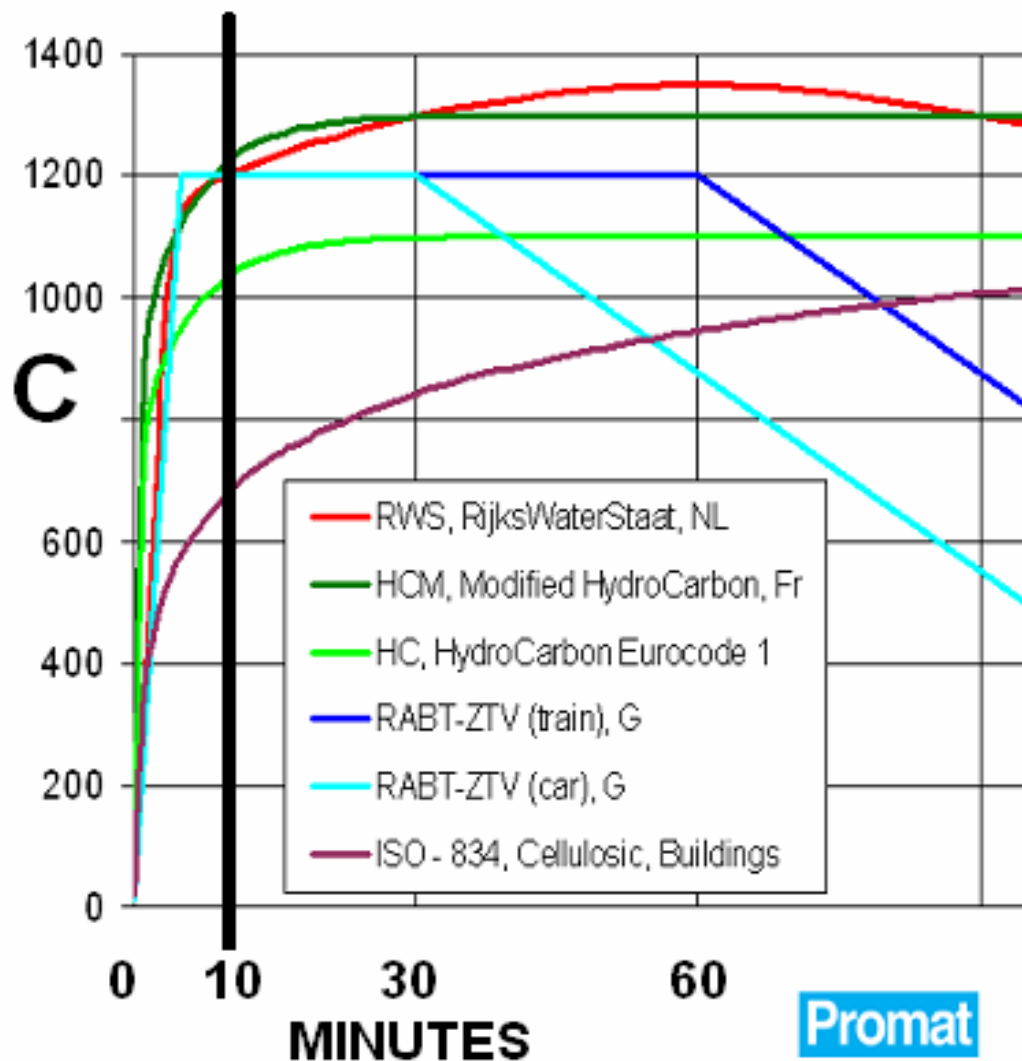
10 min

**CELLULOSIC
676 C (1248 F)**

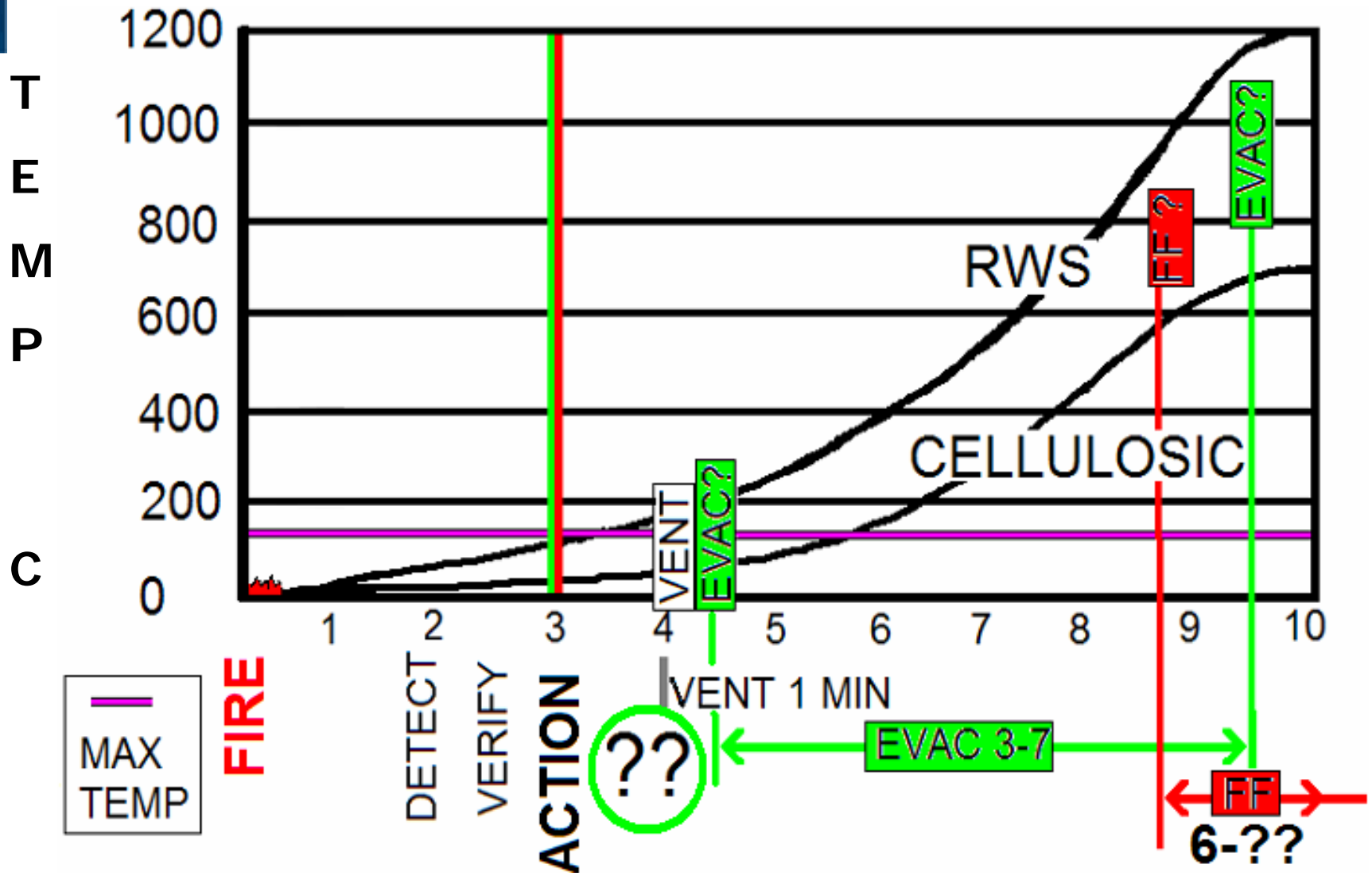
**2008 NFPA 502
RWS Curve**

10 min

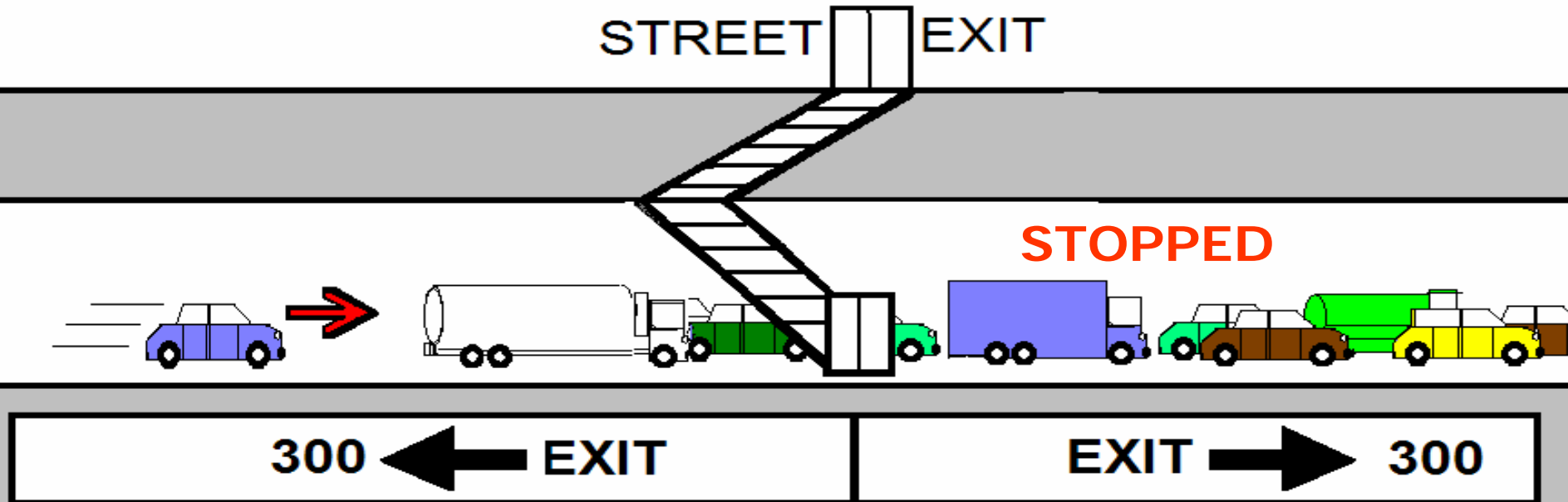
1200 C (2192 F)



First 10 minutes - RWS VS CELLULOSIC

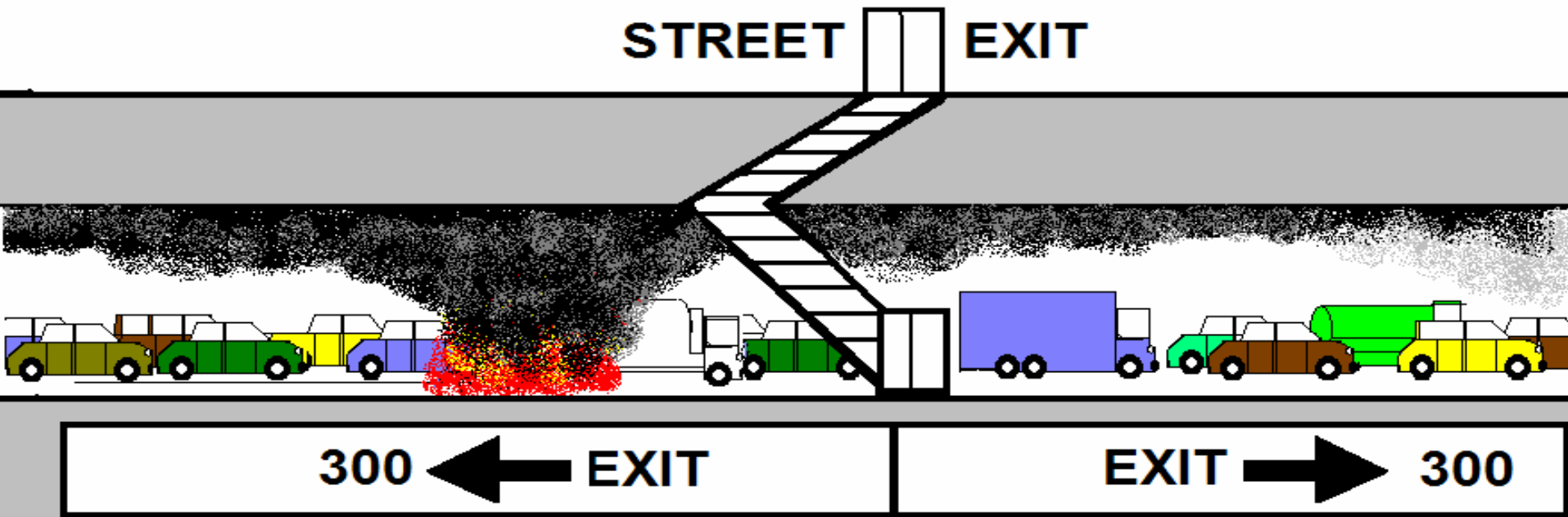


WORST CASE TUNNEL- 300 M EXITS (1000 FT) TRAFFIC CONGESTION / TANKER / FIRE



1. LONGITUDINAL VENTILATION
2. TRAFFIC SLOW OR STOPPED
2. CAR STRIKES STOPPED TANKER
3. TANKER RUPTURES

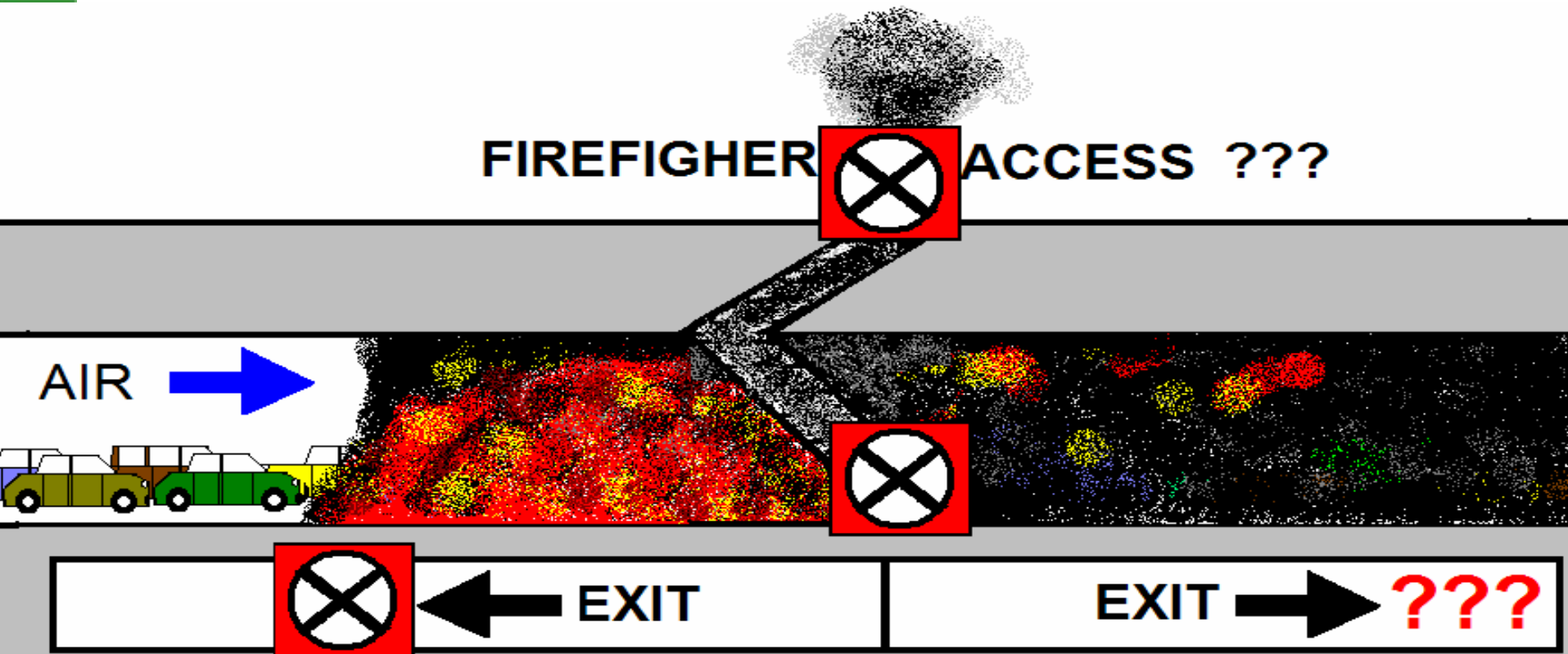
WORST CASE TRAFFIC CONGESTION / FIRE



4. FLAM LIQUID IGNITES

5. PEOPLE DOWNSTREAM **DO NOT KNOW!**

6. OPERATOR STARTS FANS, ALERT MOTORISTS



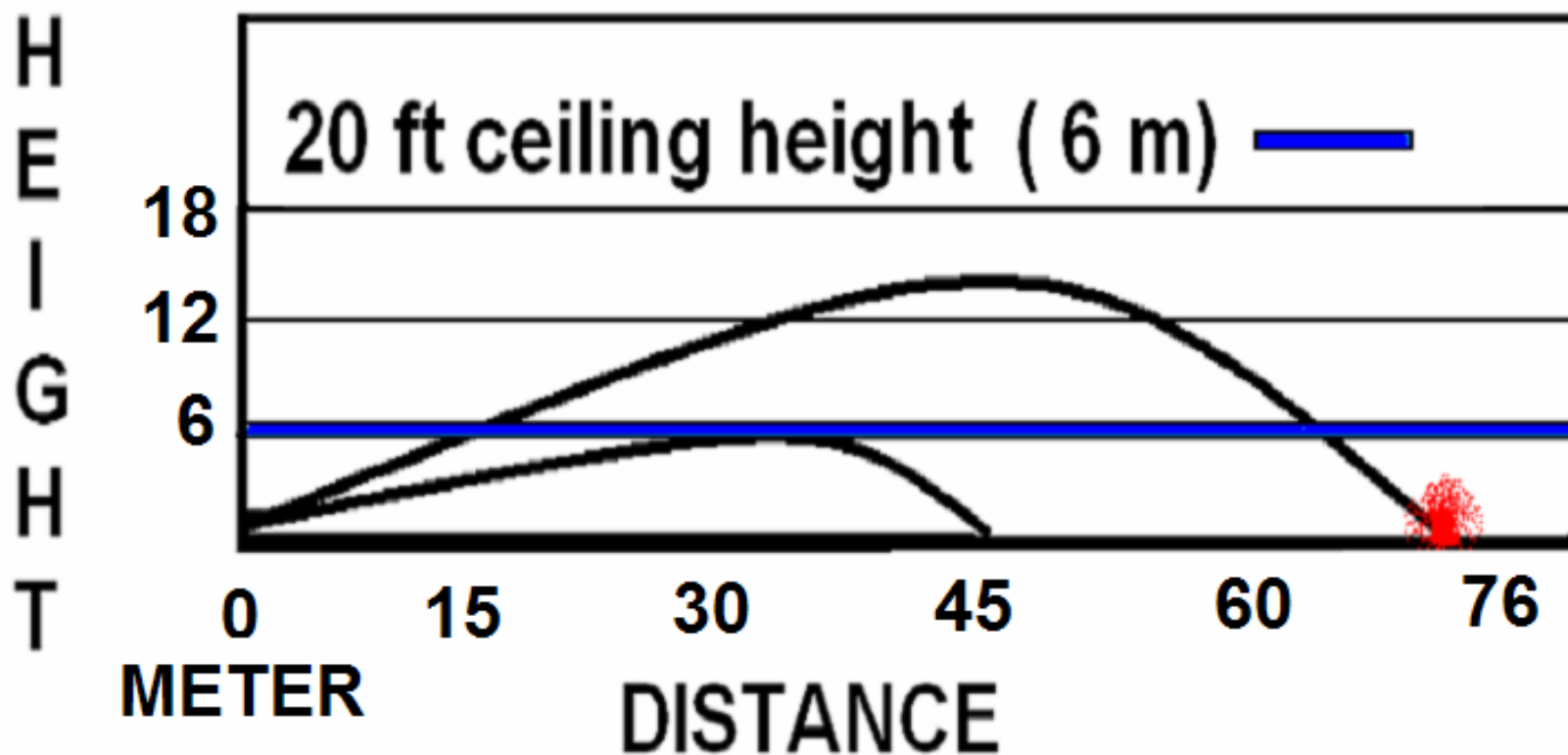
7. DOWNSTREAM MOTORISTS RUNS

8. THOSE CLOSE TO NEXT EXIT LIVE

9. FF TREAT SURVIVORS



FIREFIGHTER LIMITS - FIRE SERVICE AND TUNNELS



1200 C = ***RADIANT HEAT!***

FIRE SPREAD - VEHICLE TO VEHICLE





HUMAN REACTION TO FIRE

IN A FIRE, A NORMAL PERSON MAY BECOME:

- SLOWER**
- MAKES POOR DECISIONS**
- FORGET TRAINING**
- POSSIBLY INCAPABLE TO MOVE OR THINK**

MANY PEOPLE DO NOT KNOW:

- WHAT TO DO**
- HOW TO DO IT**
- THEY NEED TRAINING!**

FIRE SERVICE EXPECTS IRRATIONAL BEHAVIOR!

PUBLIC EDUCATION



FIRE SERVICE RESPONSE TIME - RACE AGAINST FIRE GROWTH



MURPHY'S LAW –

**“Whatever can go wrong,
will go wrong “**

FF saying

‘Murphy rides my shoulder’

WE MUST WORK TOGETHER!



LAST THOUGHTS

BE OUR PARTNER – WE WILL HELP !

Concept, Design, Construction, Operate

PRACTICE problem solving TOGETHER

**Don't count on the motorist reacting
rationally,**

Train, teach and educate our fellow motorist

Don't forget Construction Risk !

TUNNEL UNDER CONSTRUCTION





THANKS - FIRE SERVICE AND TUNNELS

GOVERNMENTS AND REPRESENTATIVE

PIARC

Tunnel Owners and Operators

Designers, Builders

Testing Labs

Motor clubs

And, my Fellow fire fighters

Remember this ,

BE PART OF THE SOLUTION,
NOT THE PROBLEM



**YOUR TUNNEL
MAY BE NEXT!**

• **BE READY!**

We **MUST**
Work
Together!

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AUTHORITY HAVING JURISDICTION

INTERNATIONAL FIRE CODE

adopted by state and city

STANDARDS – (minimums)

- NFPA 502 – Road Tunnels,
- NFPA 241 – Underground Construction
- NFPA 14 – Standpipes
- NFPA 13 – Sprinkler
- NFPA 25 – Testing/ maintenance H2O

OSHA/ (WISHA)

REFERENCES - FIRE SERVICE AND TUNNELS

NIMS

<http://www.cfdconference.com/Portals/0/Unified%20Command%20NIMS.pdf>

Seattle Tunnels

[**http://www.djc.com/news/ae/11139441.html**](http://www.djc.com/news/ae/11139441.html)

CALDECOTT

[**http://fire.nist.gov/bfrlpubs/**](http://fire.nist.gov/bfrlpubs/)

Effectiveness of Fixed Fire Fighting Systems in road Tunnels - ITA?

DANGEROUS GOODS IN TUNNELS

OPERATOR

Prevention -

limit access, inspect, sensors

Event! **THINK EXPANDING PROBLEM**

- **Containment!!**
- **Stop access, ventilation, drainage,**
- **Prevent Secondary contamination**
- **CALL FOR HELP (use your PLAN!)**

FIRE DEPT

- **Isolate,**
- **ID,**
- **evacuate,**
- **mitigate**

