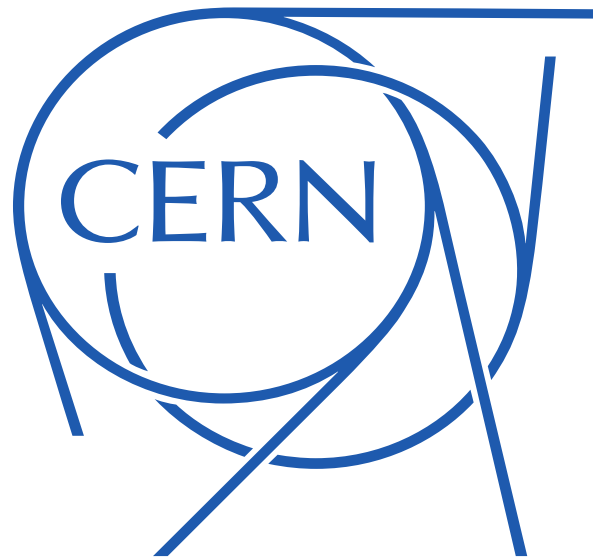




CERN Fire Brigade

DGS-SEE Seminar on fire protection for physics research facilities



CERN Fire Brigade
Art Arnalich – CERN Fire Brigade Fire Officer
M.Eng. Civil Engineering

Content

- Introduction to CERN Fire Brigade
- CERN Fire Brigade principles
- Firefighting constraints at CERN
- General tactical approach for underground facilities





GE-40115

GE-40577

1959

1956



CERN Fire Brigade



1956 1961





1956

2013



Since 1956 preserving life, property and environment at CERN



1956



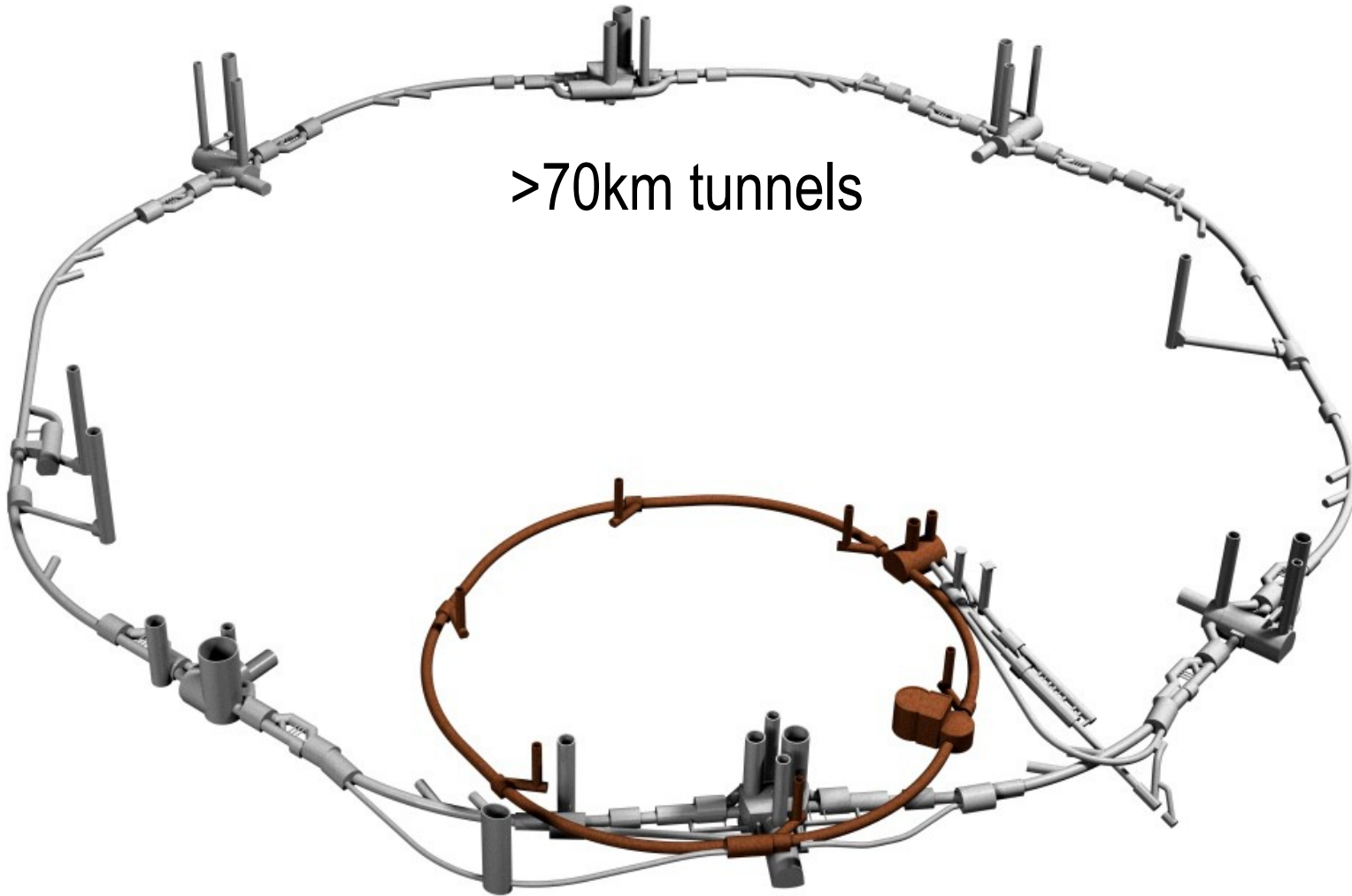
CERN Fire Brigade

- 58 members
- 10 nationalities
- 2 languages EN+FR
- ~2000 calls/year



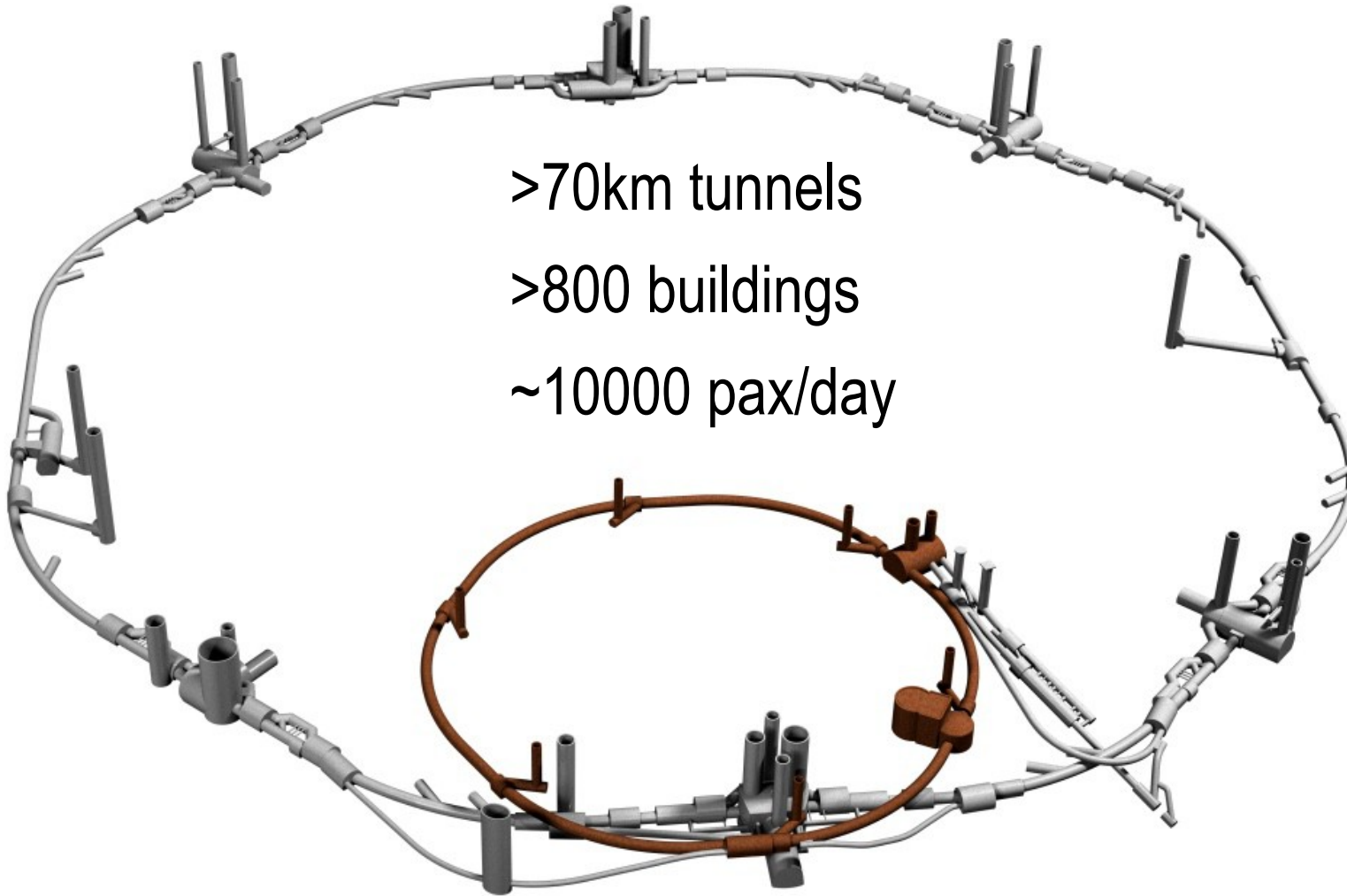
Operational area

>70km tunnels



Operational area

>70km tunnels
>800 buildings
~10000 pax/day



Appliances



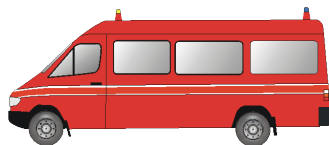
x2 **COMMAND
VEHICLE**



x2 **FIRE&RESCUE
ENGINE**

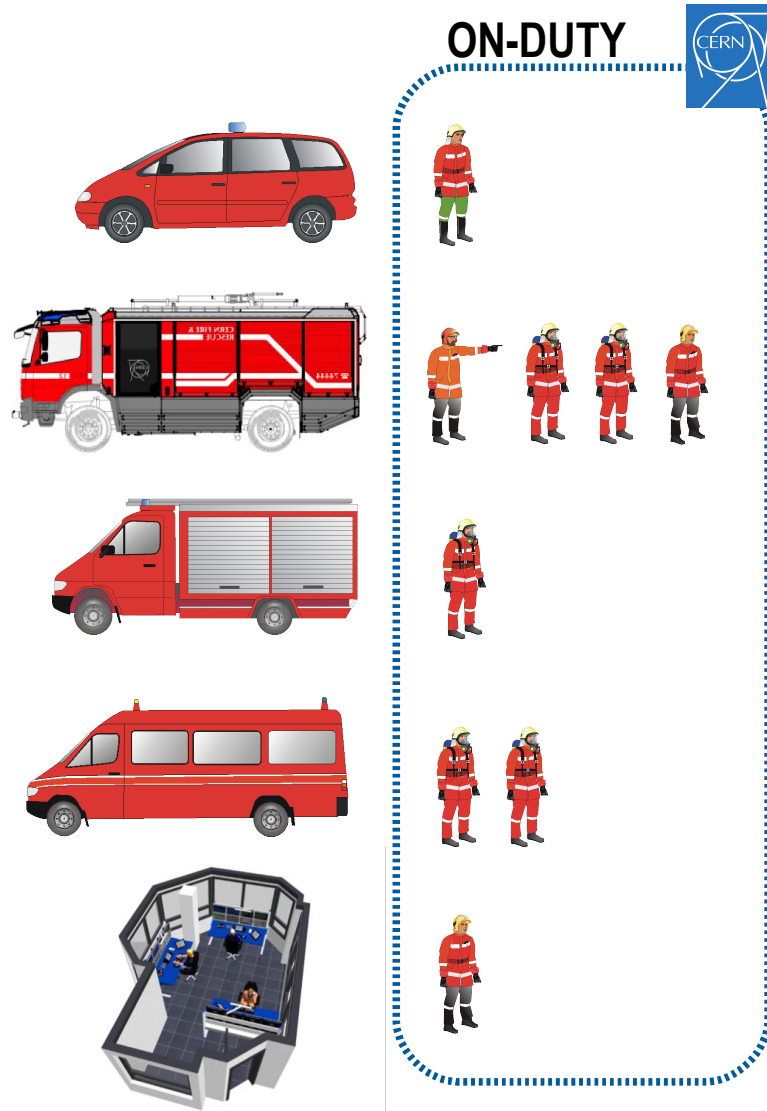


x3 **MULTI PURPOSE
TRUCK**



x2 **AMBULANCE**

On-duty resources



On-duty resources



x1 FIRE OFFICER

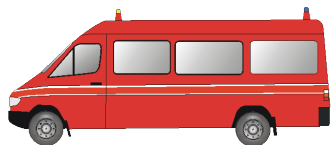


x1 CREW COMMANDER

x3 FIREFIGHTER



x1 FIREFIGHTER

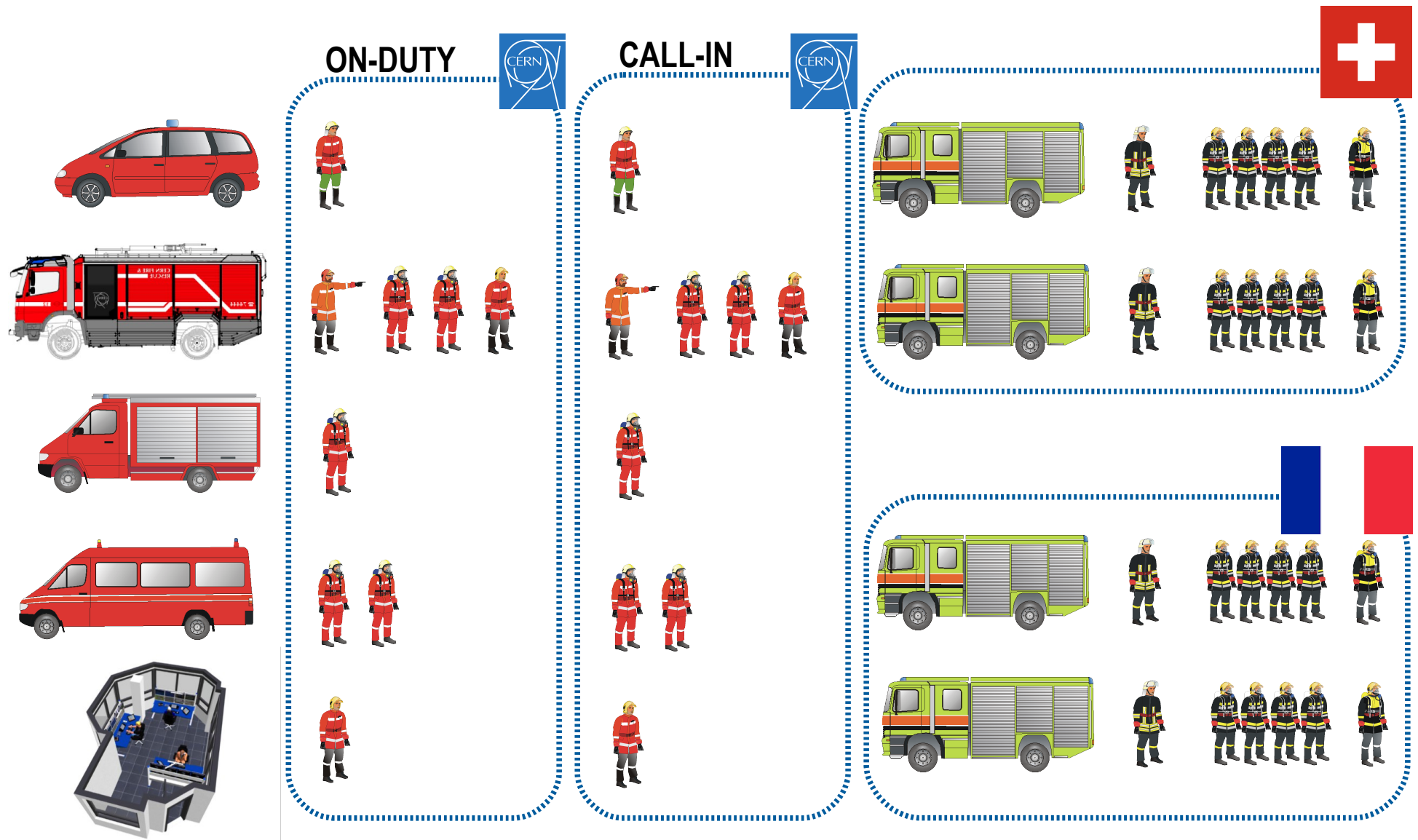


x2 EMS FIREFIGHTER



x1 OPERATOR /FIREFIGHTER

Major intervention resources



CERN Fire Brigade principles - Prevention

“Best response to an incident is having no need to respond.”

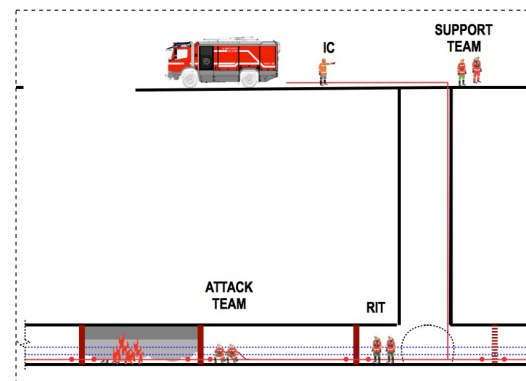
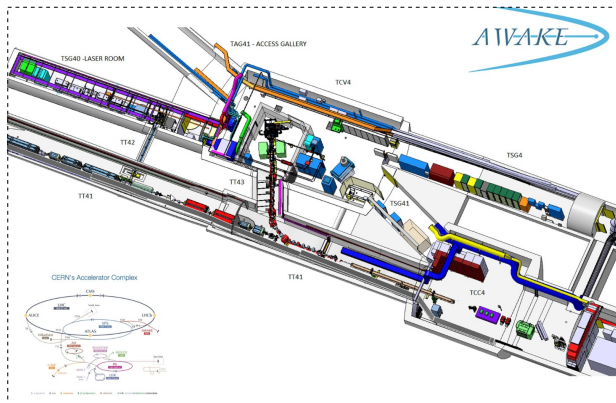


CERN Fire Brigade principles - Prevention

“Best response to an incident is having no need to respond.”

Active role in prevention

- Close collaboration with fire protection engineering
- Project assessment from fire protection standpoint
- Project assessment from **fire intervention** standpoint



CERN Fire Brigade principles - Preparedness

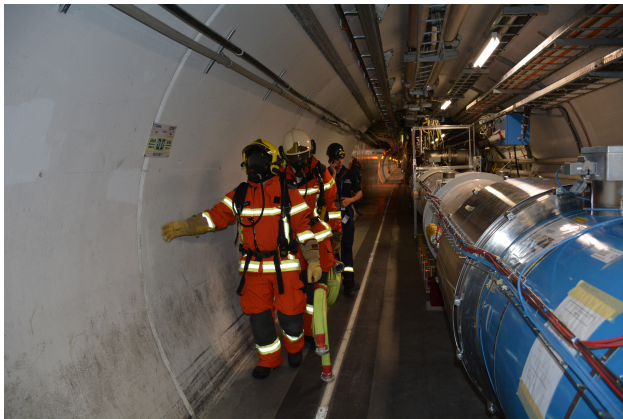
“Hope for minor intervention, be prepared for worst case scenario.”



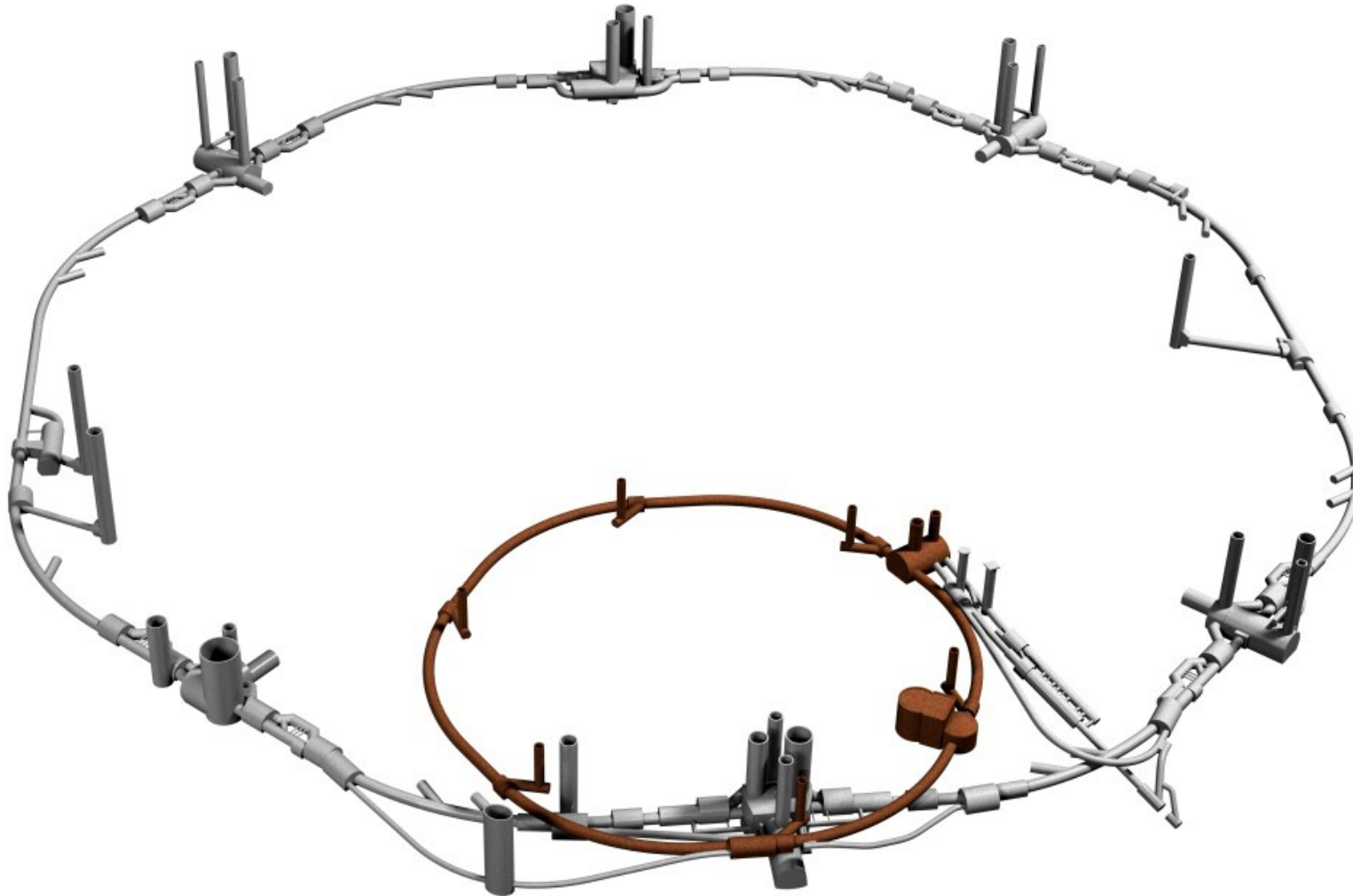
CERN Fire Brigade principles - Preparedness

“Hope for minor intervention, be prepared for worst case scenario.”

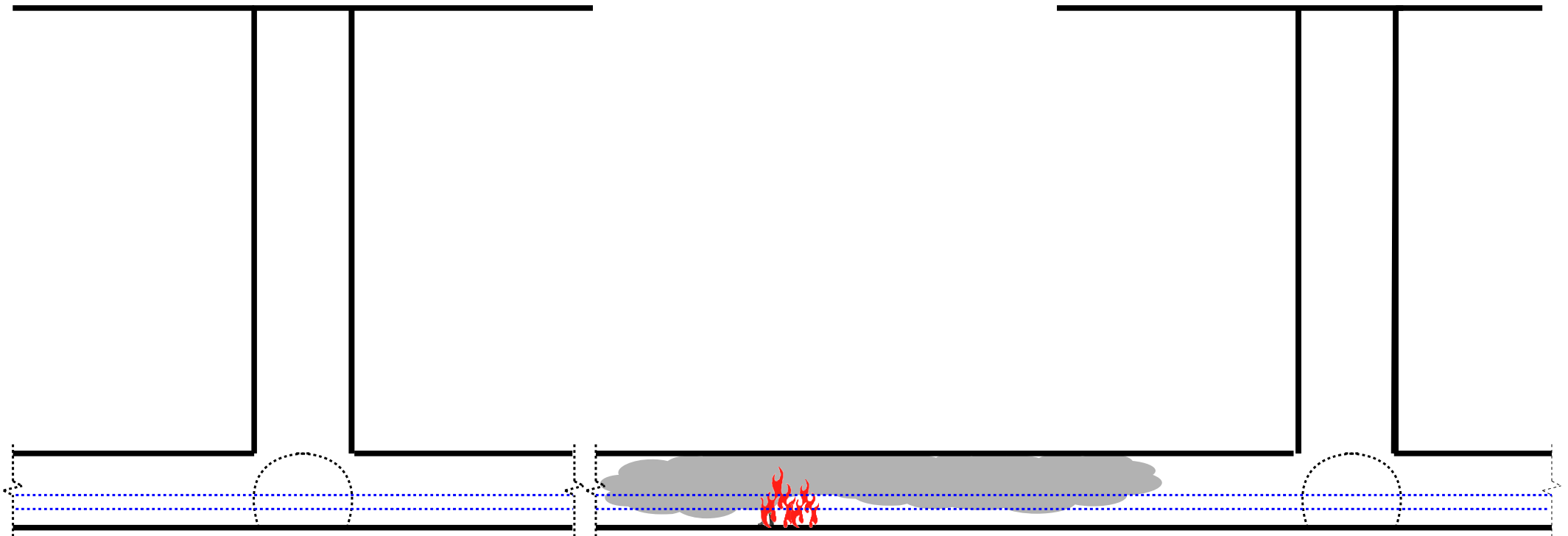
- **Intervention preparedness**
- Continuous training, skill maintenance
- Thorough state-of-the-art detection and alarm system
- Updated information from CERN Control Center



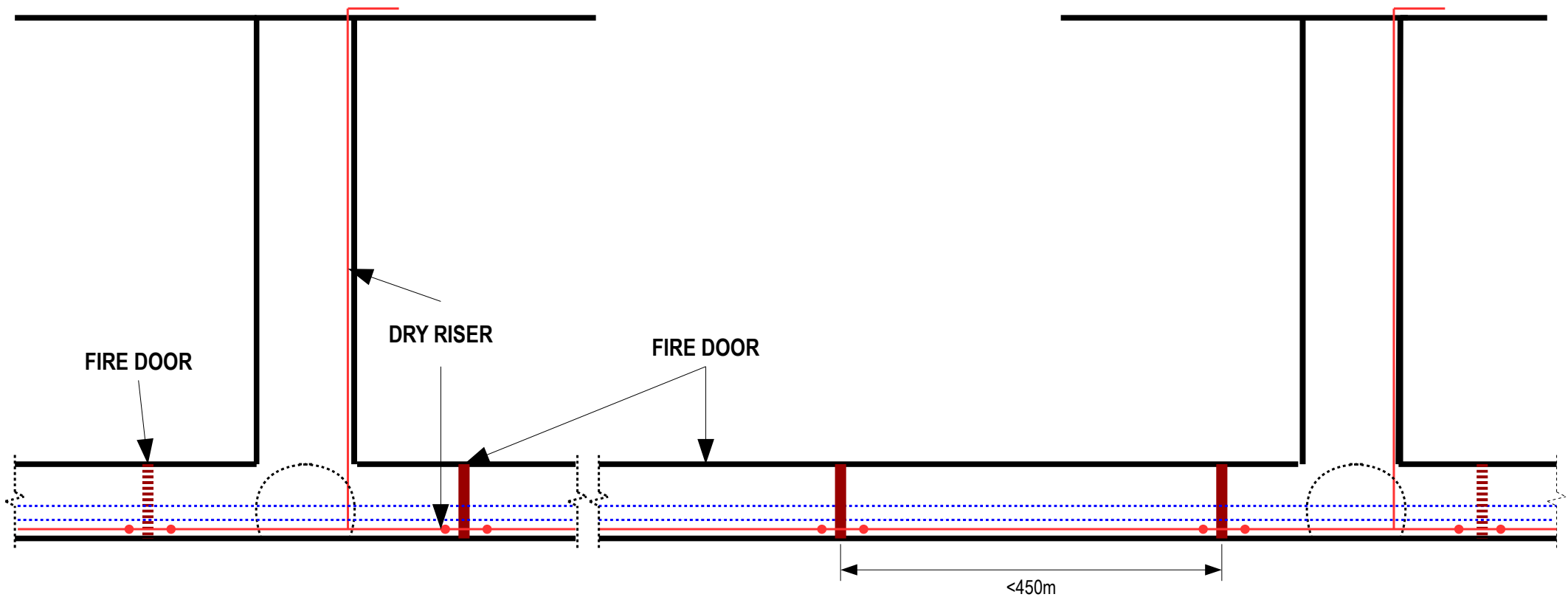
First response for underground areas



Legacy underground areas layout (SPS, CNGS,...)

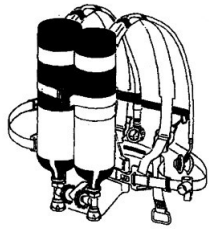


Modern/upgraded underground layout (LHC, HILUMI, SPS upgrade, AWAKE,...)

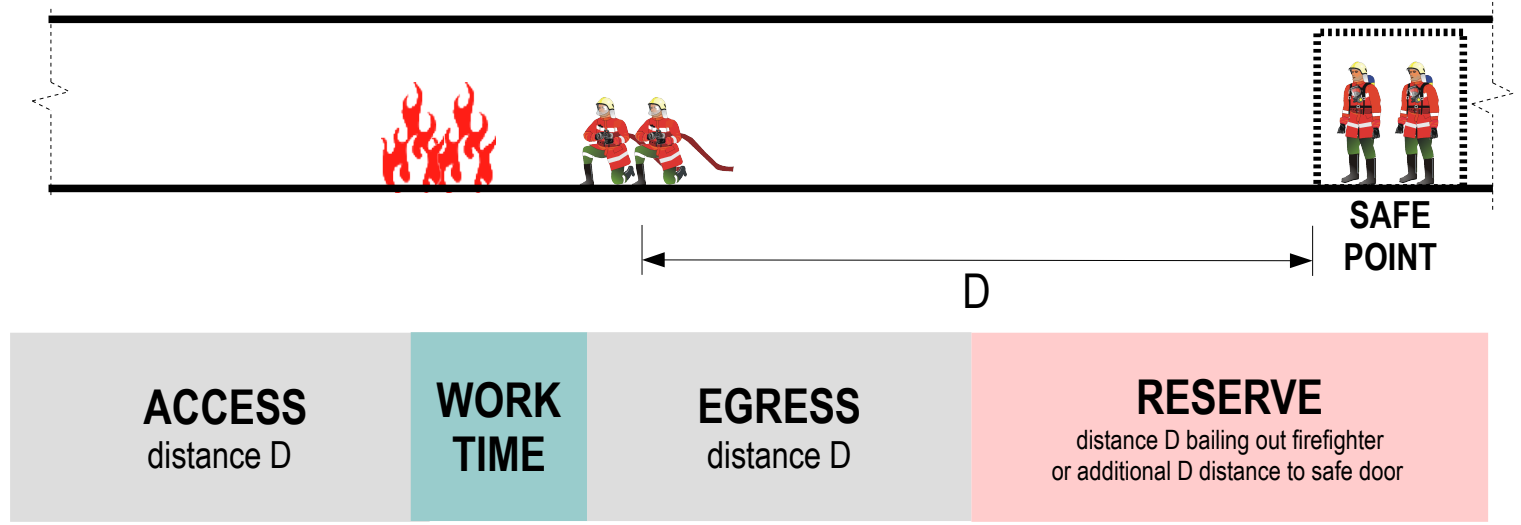


Firefighting limitations based on air supply

AIR SUPPLY

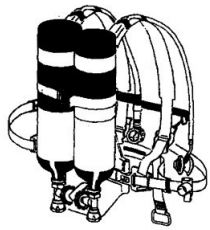


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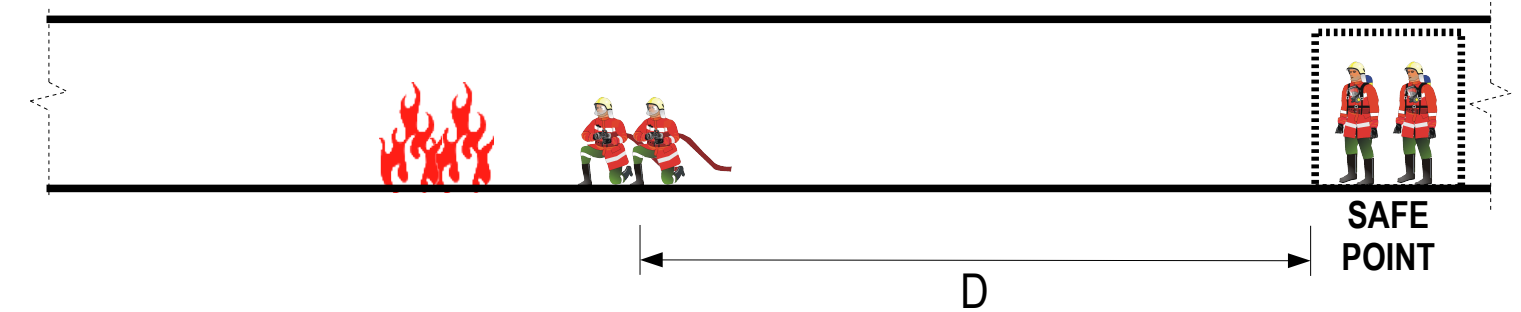


Firefighting limitations based on air supply

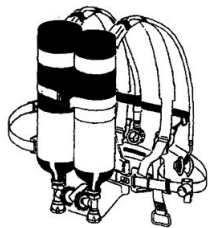
AIR SUPPLY



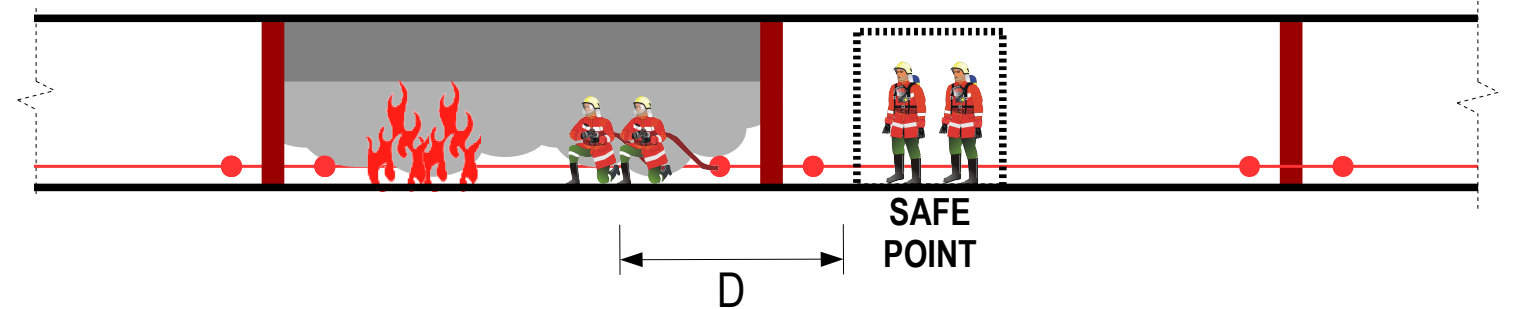
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AIR SUPPLY



=



Firefighting limitations based on air supply

Preliminary air consumption and access speed test for fully geared firefighters with twin 6,8L cylinder SCBAs performed 2015.06.17 at LHC tunnel recommend the following values for air supply:

Firefighter air consumption: 75L min⁻¹

Air supply: 2 6.8L cylinders @270bar = 3672L \equiv 49 min

Access speed : 48m min⁻¹

For **20min** work time:

FIRE DOOR LAYOUT	ACCESIBLE AREA TO FIREFIGHTERS
NO DOORS	BA TA
3 DOORS PER SHAFT (two at tunnel, one at TA)	BA TA 50% tunnel
3 DOORS PER SHAFT + 1 DOOR MID-SEXTANT	BA TA 100% tunnel

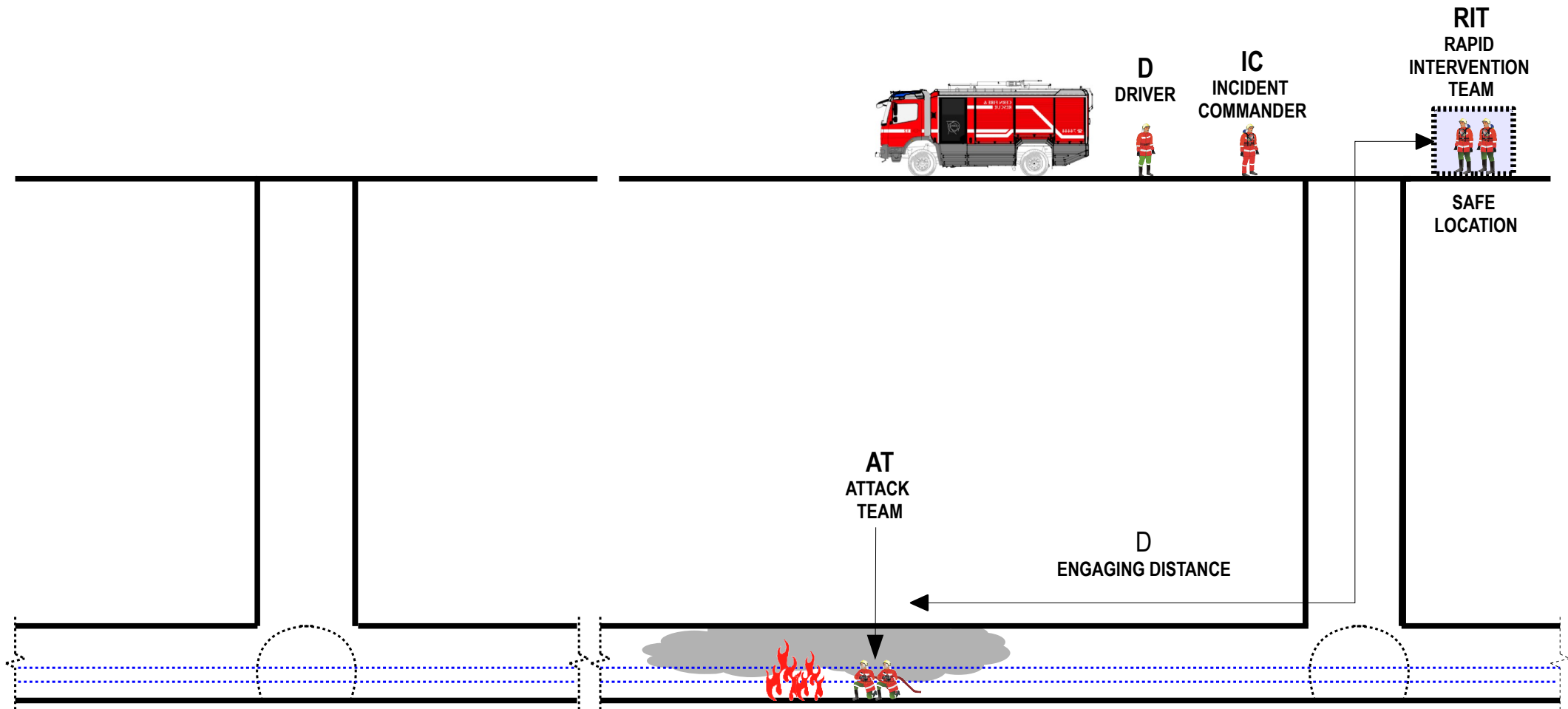


NOTES

- 20min considered the maximum time for fire control without team swap
- 25% safety factor introduced in air consumption and access speed due to limited sampling on test
- 10min and 750L of air were taken as a value for tunnel access from surface through stairs
- Reserve air supply calculated to be enough to reach an additional fire door, to exit to surface or to allow 10min air supply in case of emergency
- Test performed by Crew Manager Manel Parada. Report available.



Tactical approach on legacy underground areas (SPS, CNGS,...)



Fire response based on fire power (HRR)

OFFENSIVE

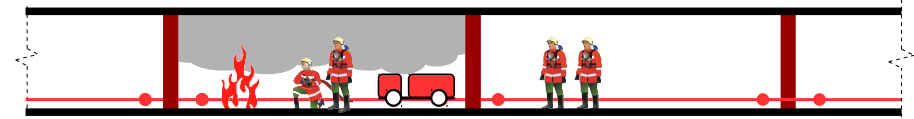
FIRE ATTACK EXTINGUISHERS

<25kg fuel load



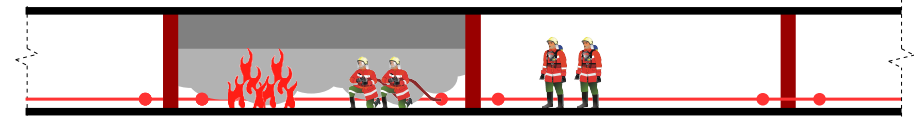
FIRE ATTACK PORTABLE CAFS

HRR <5MW + direct attack possible



FIRE ATTACK WATER DRY RISER

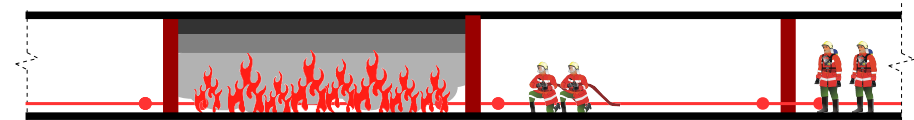
HRR <20MW + direct attack possible



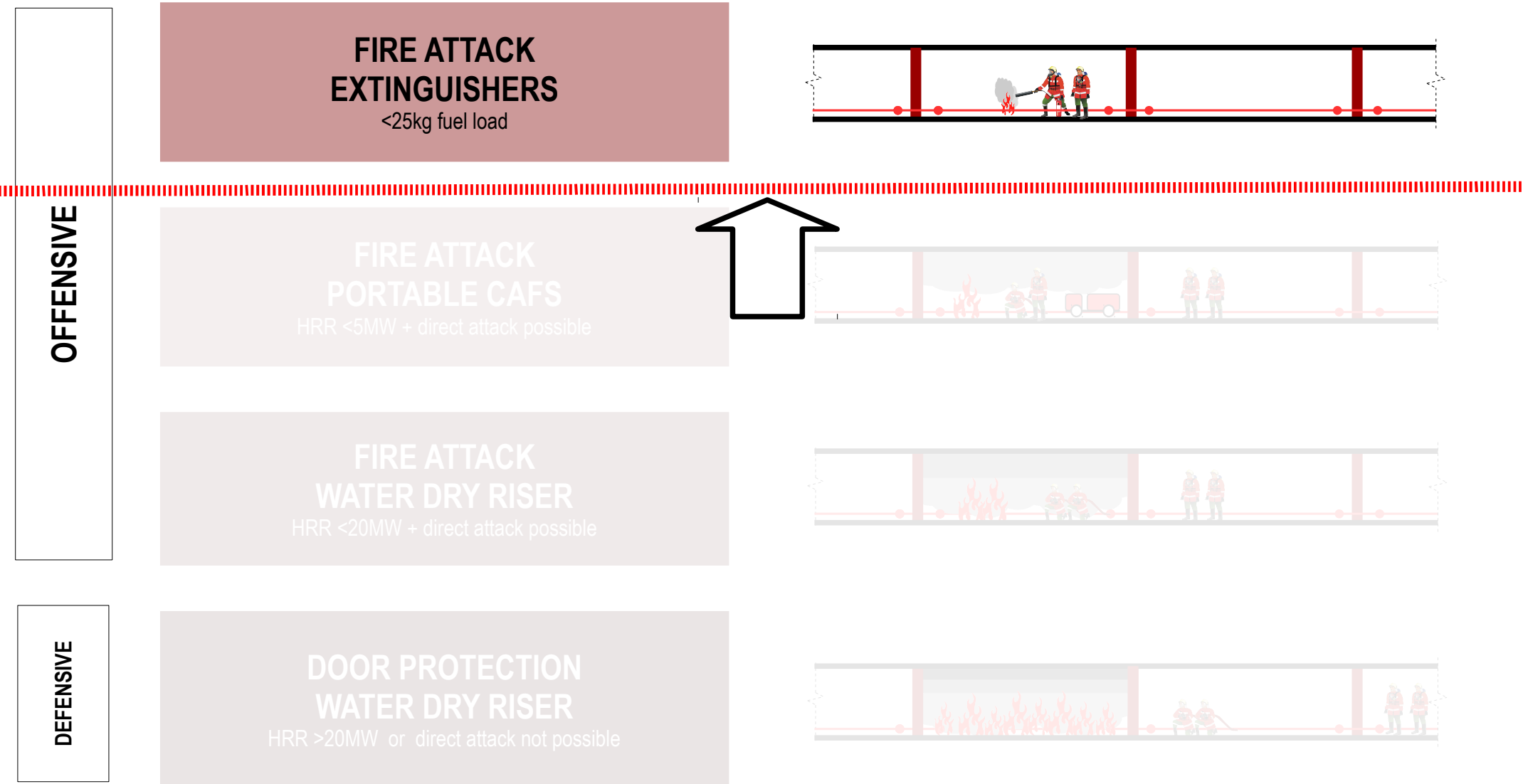
DEFENSIVE

DOOR PROTECTION WATER DRY RISER

HRR >20MW or direct attack not possible



Fire response based on fire power (HRR)



Means to increase HRR fire response

PORTABLE CAFS

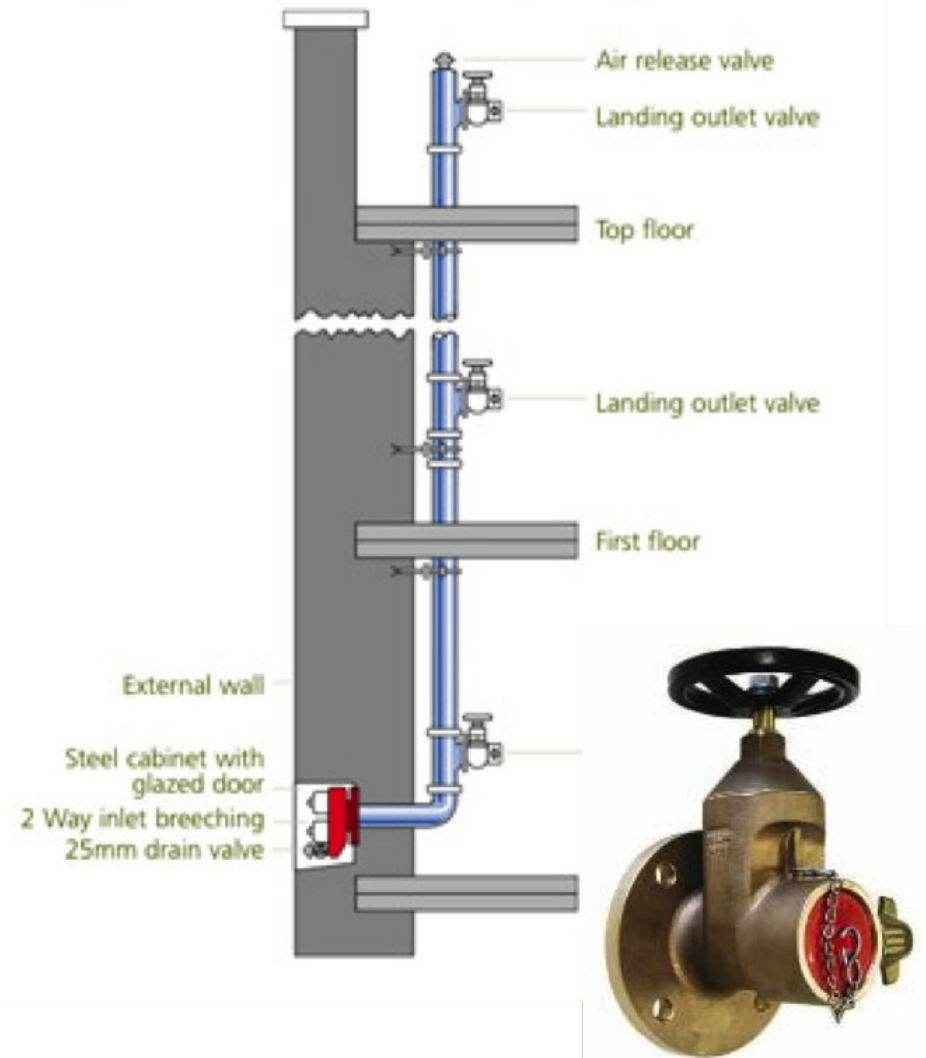
- 5MW portable CAFS
- mounted on actual trailer system
- 100m hose reel
- Present at every shaft



DRY RISER

- 500 L min⁻¹
- pipe all around SPS
- guide line attached
- outlets at every door side
- additional outlets every 90m

Typical Arrangement of Dry Rising Main

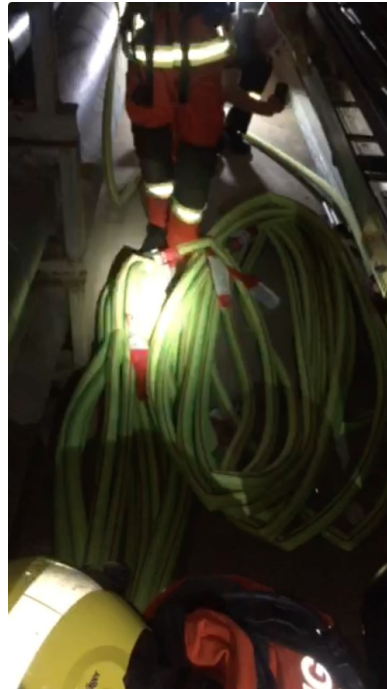


Limitations based on hose advance

Preliminary hose layout and advance techniques with water charged 40mm hoses recommended a maximum distance of 90m between water outlets (80m hose layout) yielding the following results:

Firefighter air consumption: 189L min⁻¹

Access speed: 19m min⁻¹



NOTES

•Footage and pictures of performed the performed test by Green Section and led by firefighter Ivan Gonzalez are available.



Additional firefighting means

POSITIVE PRESSURE SYSTEM AT EVERY SHAFT

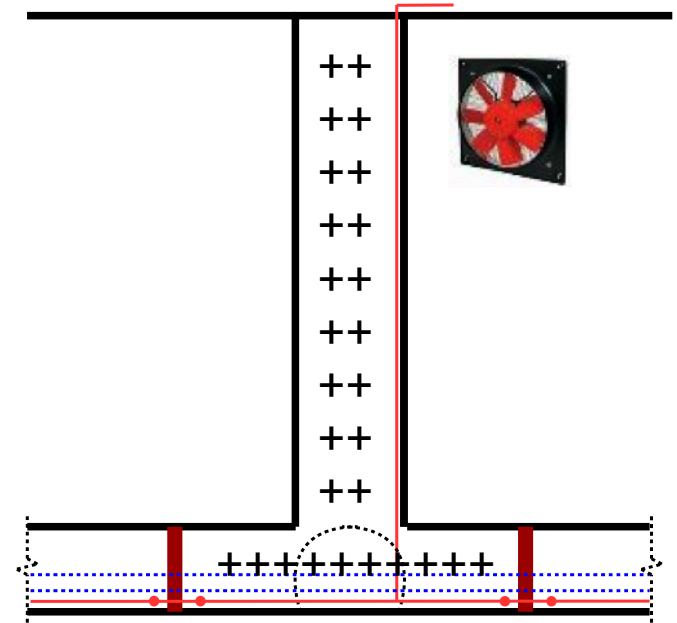
- 15Pa overpressure at shafts
- protect stairwell and avoid smoke spread

PORTABLE EXTRACTION SYSTEM

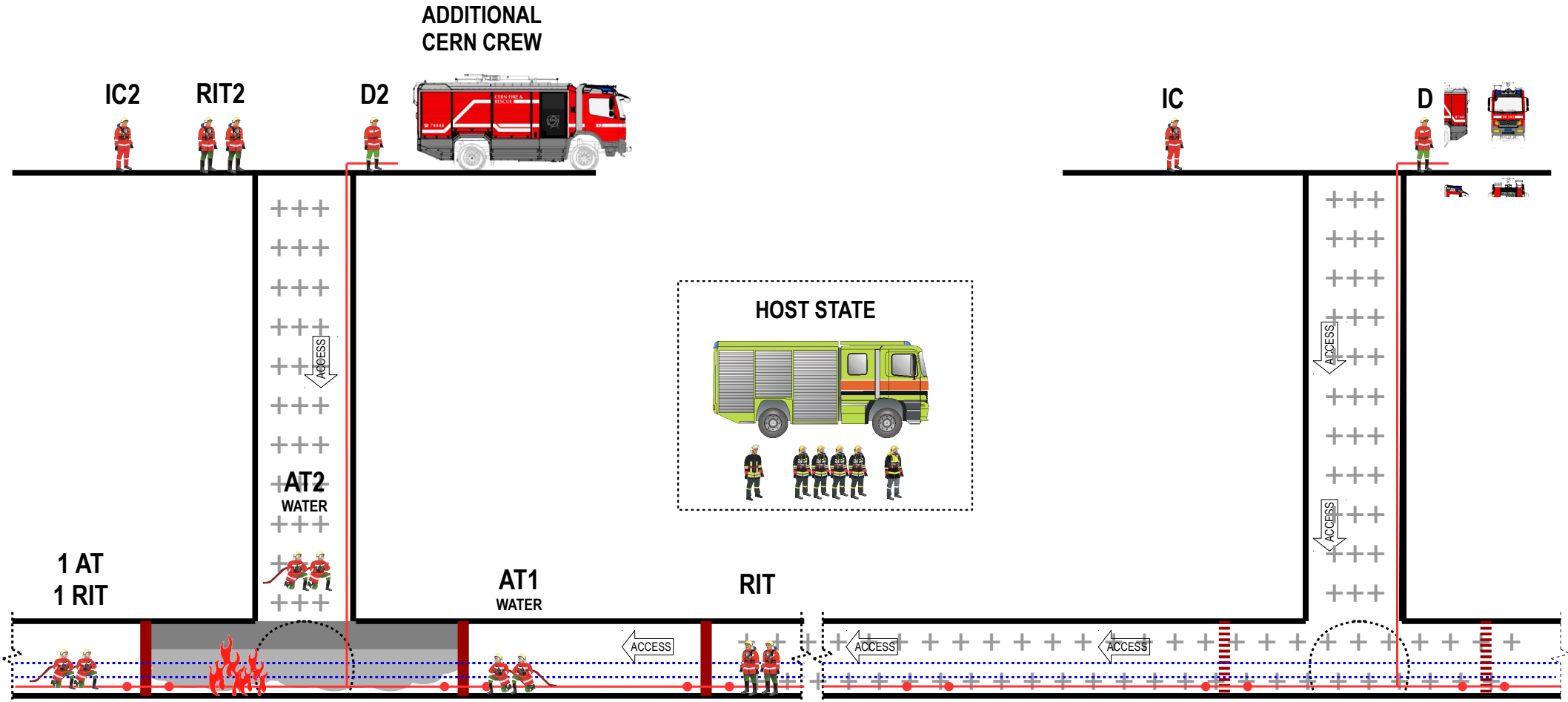
- Duct based portable extraction system to remove smoke according to RP smoke removal policy once fire is suppressed

ON SITE TRAINING

- Such a complex scenario cannot be faced unless regular training on site for the Standard Operating Procedure (SOP) is delivered to all firefighting crews



Tactical approach on modern/upgraded underground areas (LHC, HILUMI, SPS upgrade, AWAKE,...)



Thanks for your attention! / Merci de votre attention!



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art.arnalich@cern.ch**