



HSE
Occupational Health & Safety
and Environmental Protection unit

Fire safety at CERN

North Area Fire Safety Technical Review Meeting

Saverio La Mendola HSE-OHS-IB

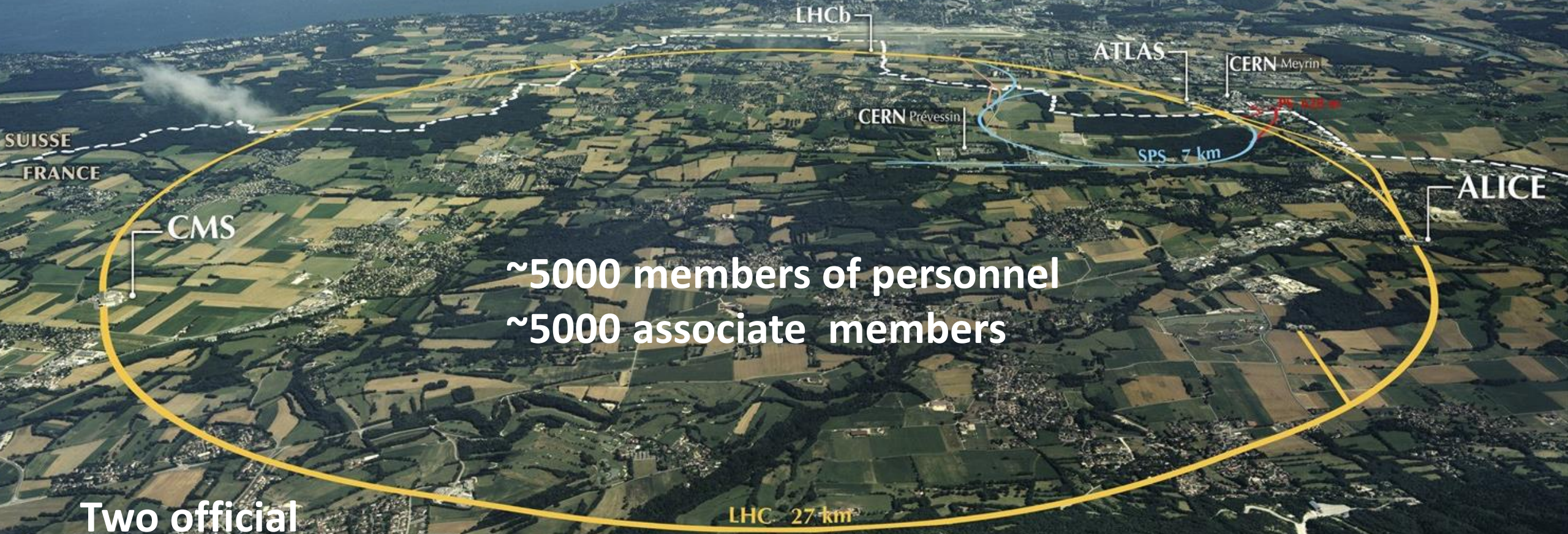
13/01/2021

EDMS 2465336 v.1

What's CERN?



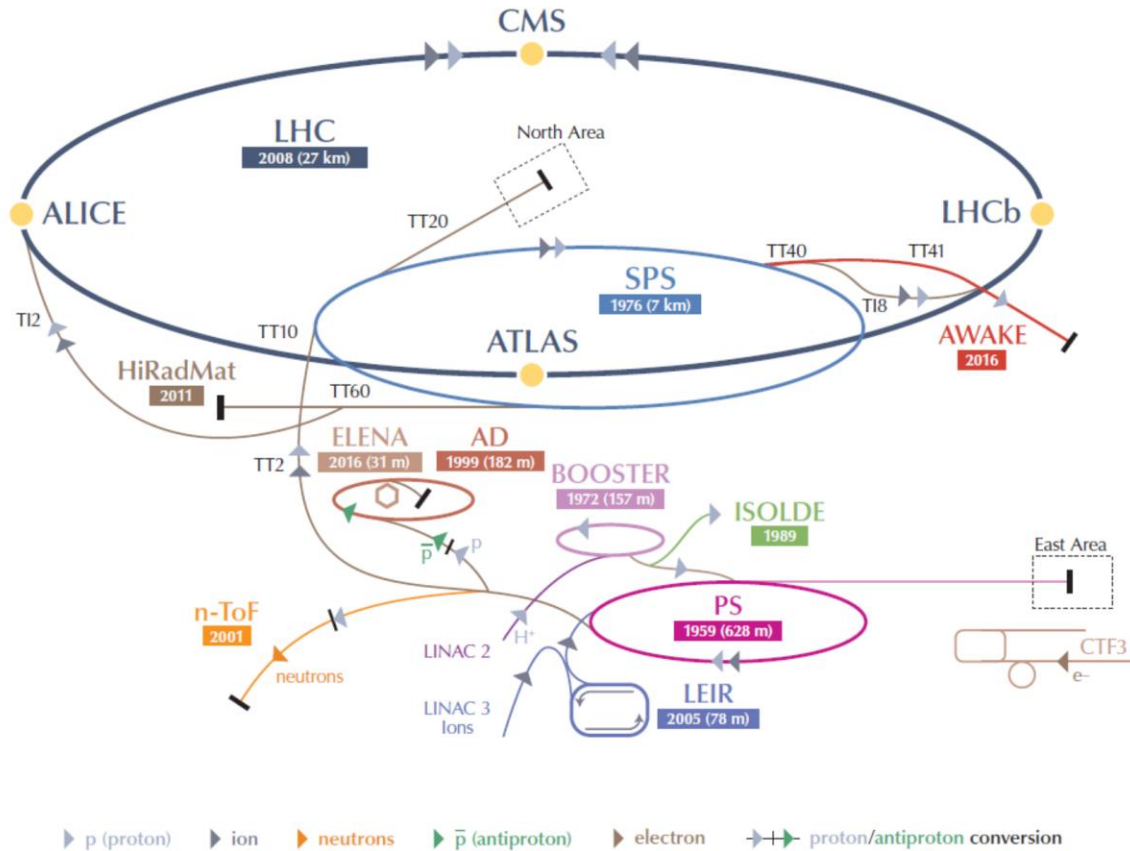
Since 1954
23 member states
~600 universities



~5000 members of personnel
~5000 associate members

Two official
languages

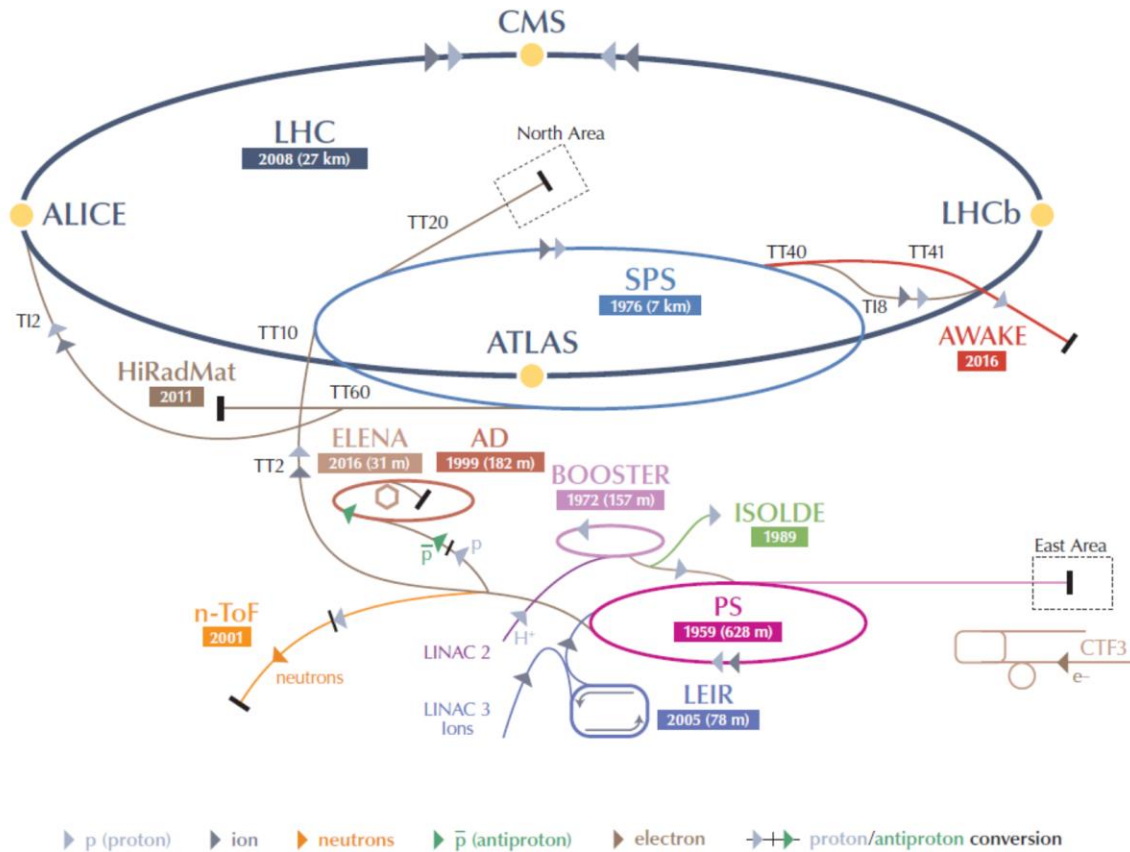
Some Key Numbers



- 45 km of accelerator tunnels
- Radioactive and chemical laboratories
- Workshops
- 60 access points
- 160 experiments
- 800 buildings
- 19'000 installations
- 3 hotels
- 1 nursery

LHC Large Hadron Collider SPS Super Proton Synchrotron PS Proton Synchrotron
 AD Antiproton Decelerator CTF3 Clic Test Facility AWAKE Advanced WAKEfield Experiment ISOLDE Isotope Separator OnLine DEvice
 LEIR Low Energy Ion Ring LINAC LINear ACcelerator n-ToF Neutrons Time Of Flight HiRadMat High-Radiation to Materials

More Key Numbers



- 2300 employed member of personnel
- 1400 other member of personnel
- 12500 users from about a 100 countries
- 3500 contractors

- Budget: 1127.2 MCHF

LHC Large Hadron Collider SPS Super Proton Synchrotron PS Proton Synchrotron

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Fire safety challenges at CERN: diversity of occupancies



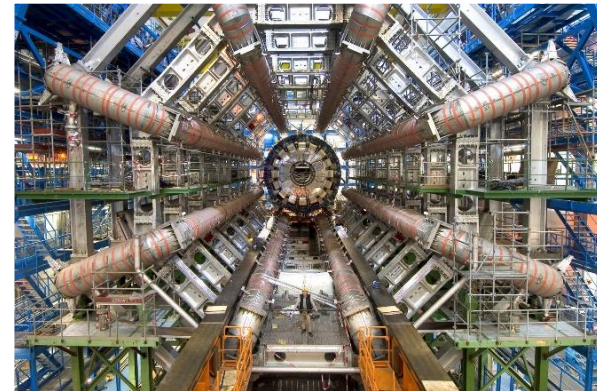
Administrative buildings



Public buildings

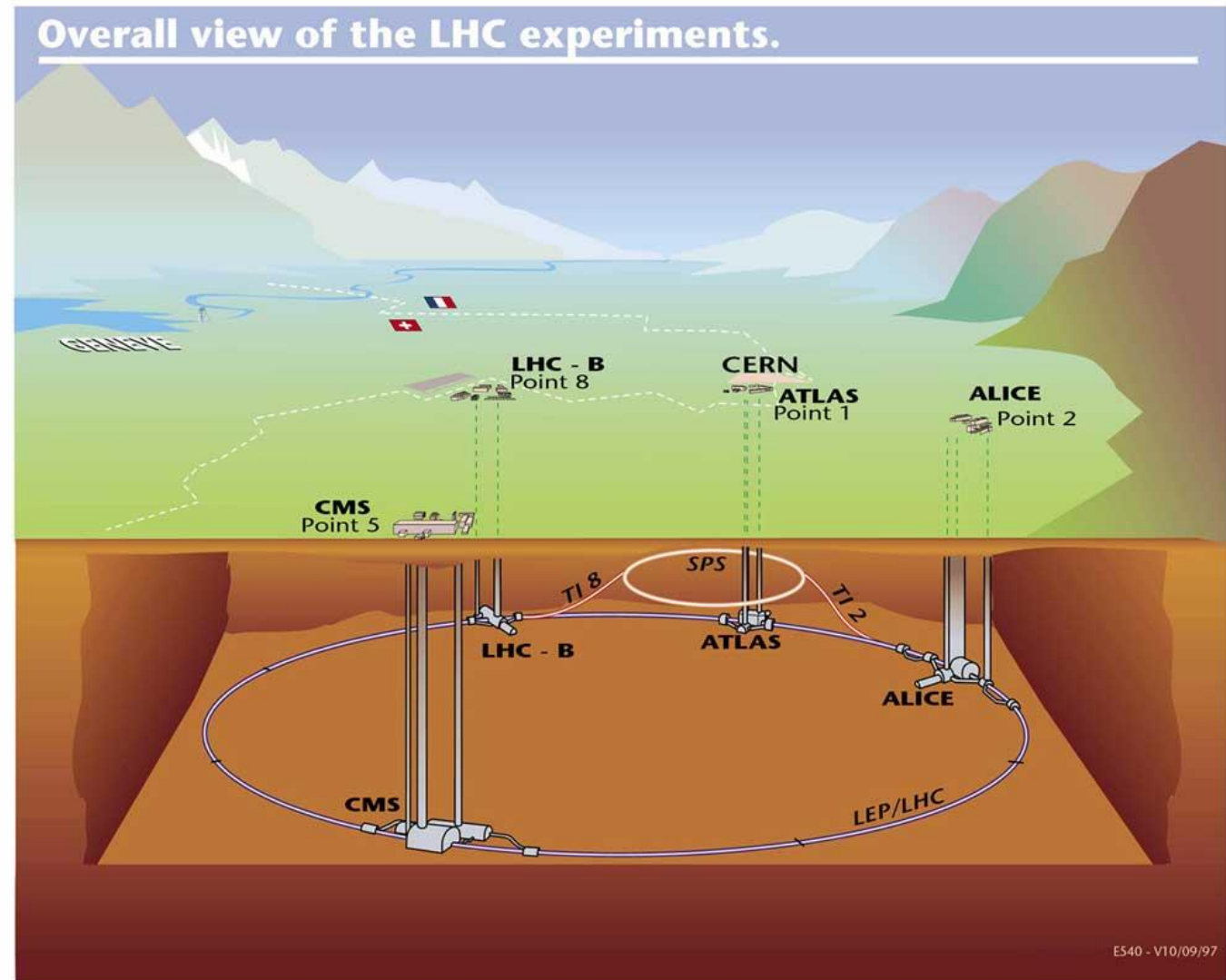
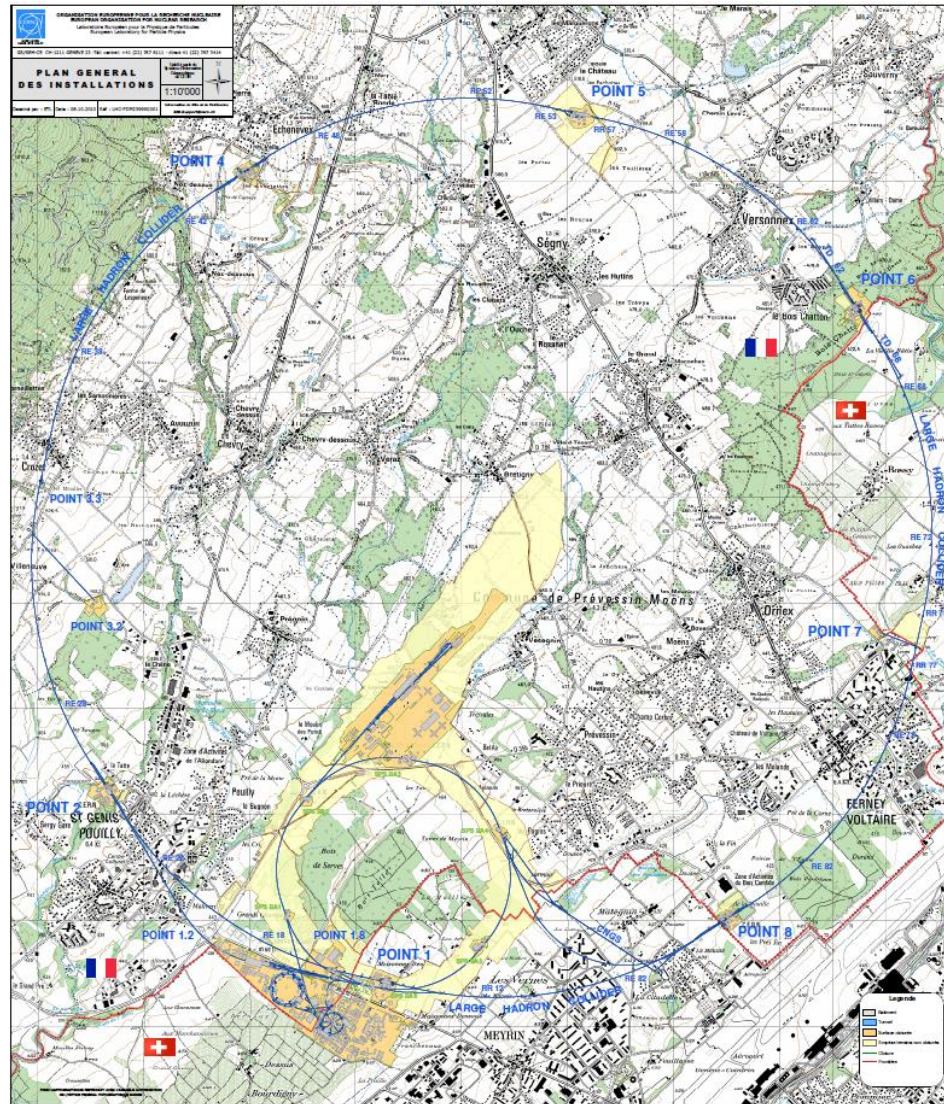


Technical facilities



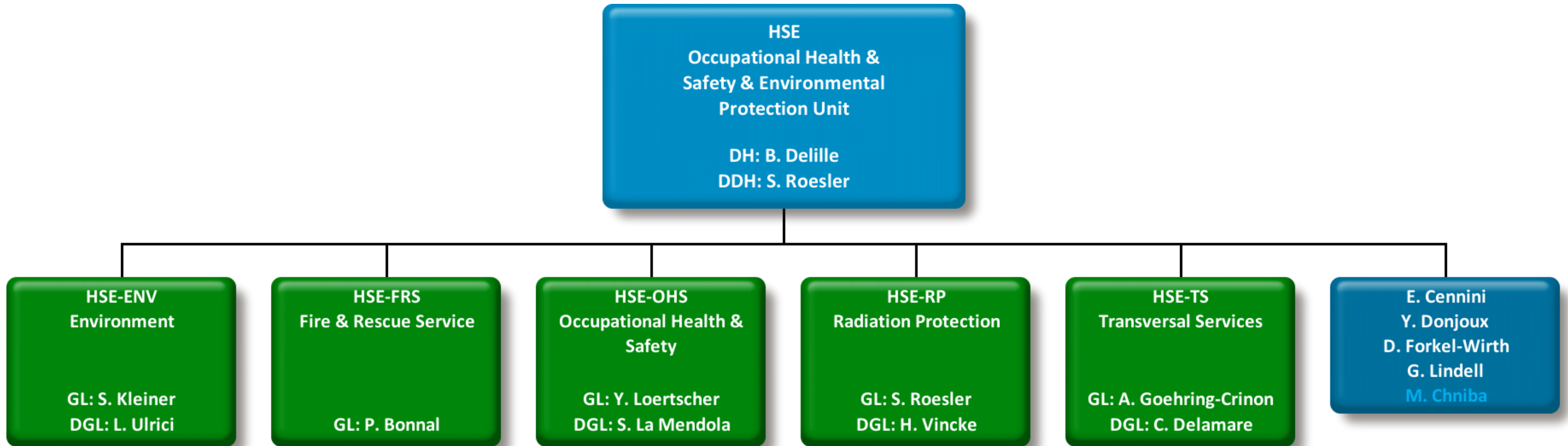
Research facilities

Fire safety challenges at CERN: sites and facilities crossing the border



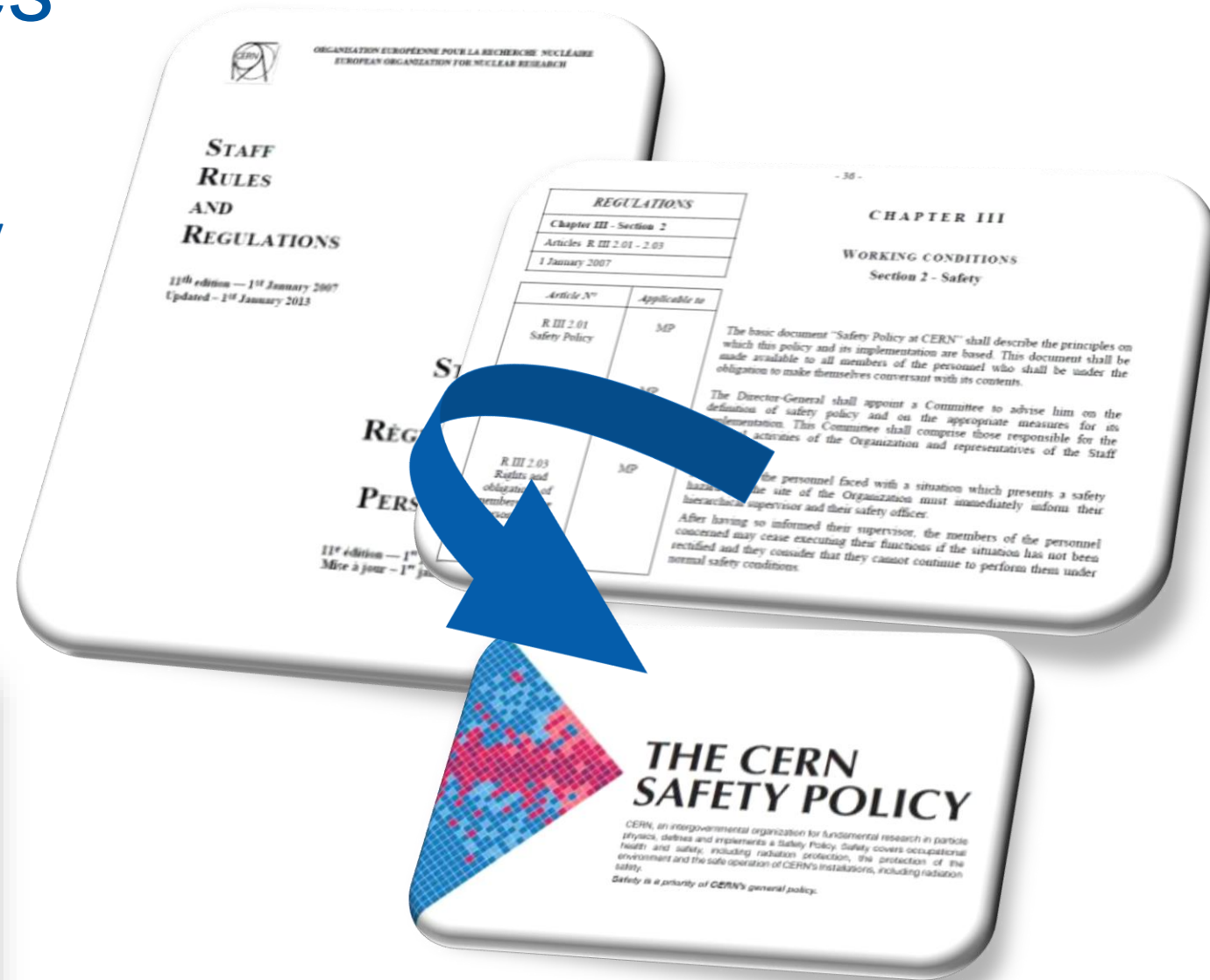
E540 - V10/09/97

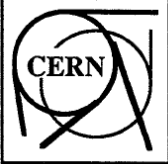
CERN HSE unit



Legal References

- As an intergovernmental Organization CERN has its own Safety policy and where necessary issues Safety regulations for its own staff and property, independently of the Host States (CH and FR);
- In practice, unless otherwise specified by CERN fire safety rules, the regulation in force in Host States is applied on a territorial basis;
- Reference for fire protection is safety code E now being replaced by a new cluster of fire safety rules;

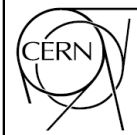


	CODE DE SÉCURITÉ SAFETY CODE	E Rev.
Issued by: Director-General		Date of revision: July 1995 Original: French * (except Appendix IV)
FIRE PROTECTION		

Fire safety challenges at CERN: Large amount of cables underground



The largest fire load in experiments & facilities is made by hundreds thousands km of cables.

	INSTRUCTION DE SÉCURITÉ SAFETY INSTRUCTION Mandatory as defined in SAPOCO/42	IS23 Rev. 3
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Issued by: SC/GS

Date of revision: February 2005
Original: English

Criteria and Standard Test Methods for the Selection of Electric Cables and Wires with Respect to Fire Safety and Radiation Resistance

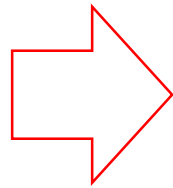
	INSTRUCTION DE SÉCURITÉ SAFETY INSTRUCTION Mandatory as defined in SAPOCO/42	IS41 Rev. 1
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Issued by: SC-GS

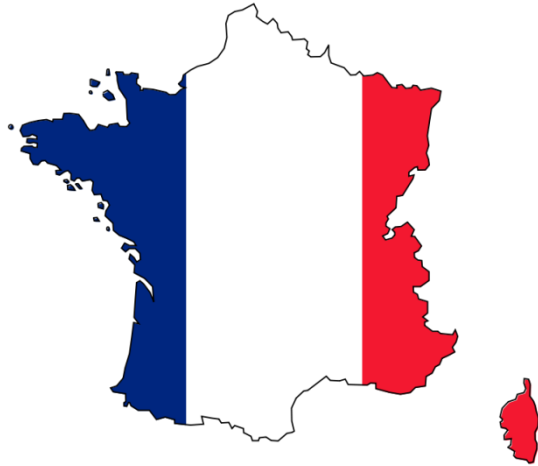
Date of revision: November 2005
Original: English

The Use of Plastic* and other Non-Metallic Materials at CERN with respect to Fire Safety and Radiation Resistance

Normal commercial-grade cables (PVC, rubber Polyethylene) present problems in case of fire.



Fire safety challenges at CERN: different legislative references in CH/FR



FRANCE

- Labour code (*Code du travail*);
- Public building regulation (*Règlement ERP, Établissements Recevant du Public*);
- Installations classified for environmental protection (*ICPE*, **only technical prescription, not the administrative ones**)
- Technical instructions IT 246 for smoke extraction;
- APSAD insurers rules (not compulsory).

SWITZERLAND

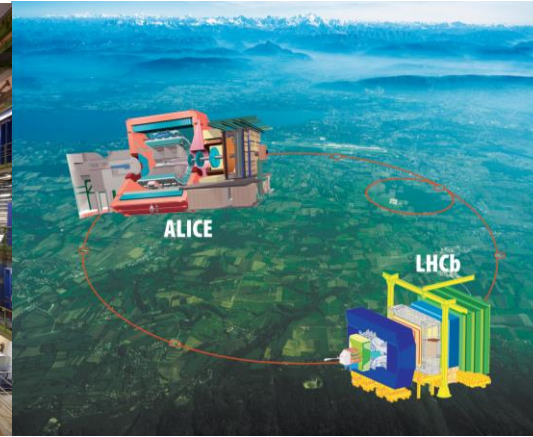
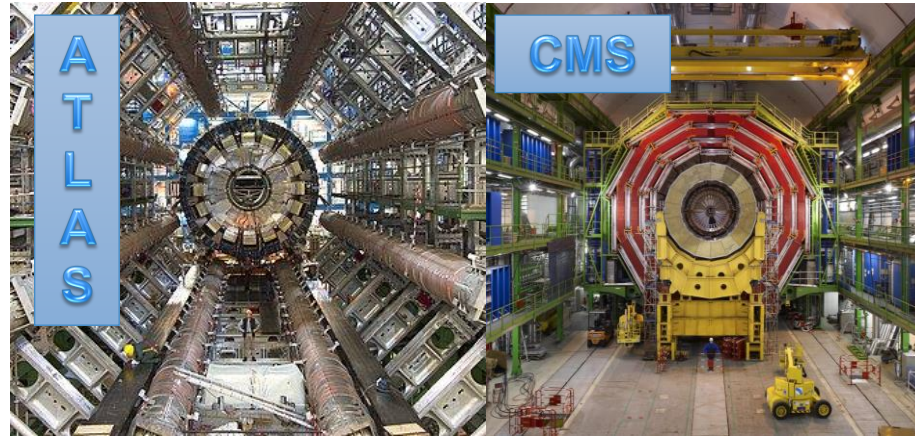
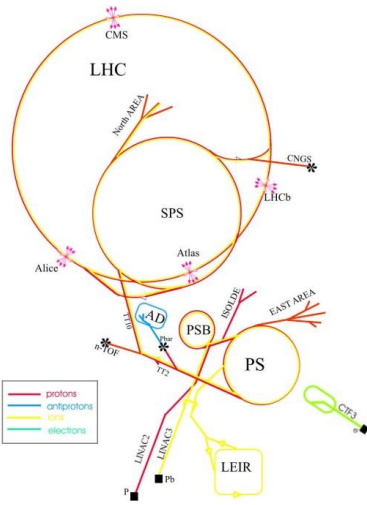
- Implementing regulation of the law on loss prevention (Canton of Geneva);
- Implementing regulation of the building code (Canton of Geneva);
- Swiss AEAI insurers directives (compulsory);
- Dispositions 3 and 4 relating to labor law;
- Dispositions for the use of unsealed radioactive sources.



In addition, relevant international, European and national technical standards are applied

Fire safety challenges at CERN: unique accelerators/experiments

Particle Detectors



Particle Accelerators



CERN safety code E – Fire protection

6.1 General

Every structure shall meet the standards, regulations, and normal trade practice concerning fire prevention and protection.

6.2.1 New buildings

In the absence of any specific CERN regulations on the subject as laid down by SAPOCO/42, the designer of new buildings shall observe the principles of the provisions concerning structures and equipment covered by the regulations of the Host Countries⁷⁾ on their respective territories. These provisions are included in the documents listed in Appendix III.

6.2.3 Buildings open to the general public

The regulations governing "buildings accessible to the general public" in force in the Host Countries shall be applied on their respective territories.

6.2.4 Special cases

In view of the very special nature of the use of certain areas, especially those underground, which involve increased fire hazards, the TIS Commission is the authority for approving and, where necessary, stipulating special provisions, as listed in Appendix III.

3. SPECIAL PROVISIONS

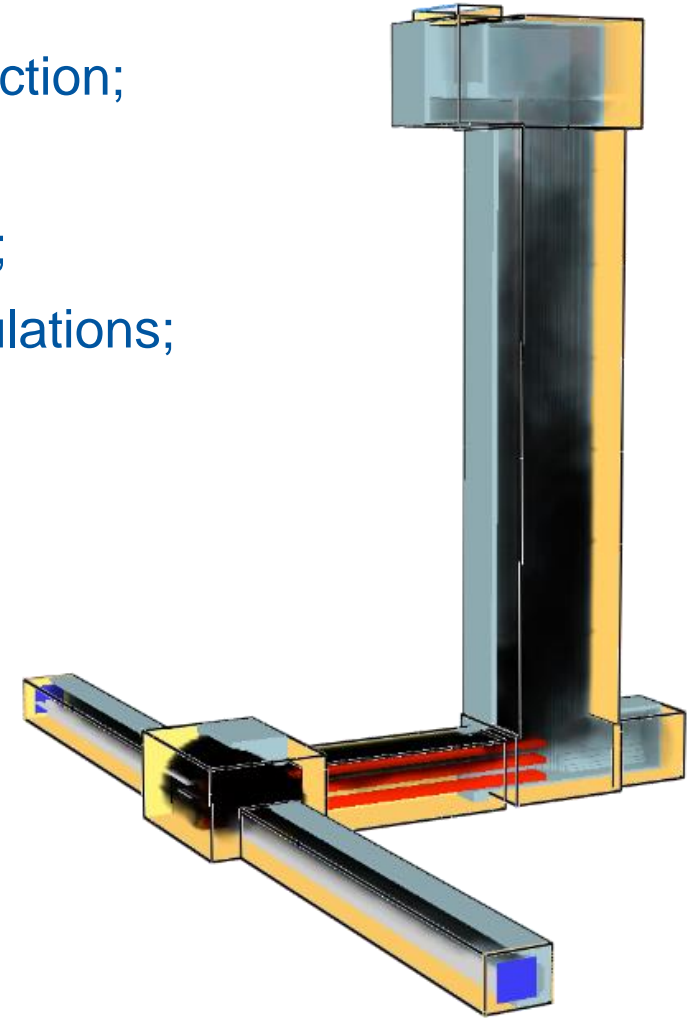
Where there are special hazards, the TIS Commission reserves the right to require the additional or more stringent measures which it deems fit.

Safety Code E is mainly based on the prescriptive approach for "normal" cases.

A reference to the performance-based approach is made at §6.2.4 Special cases.

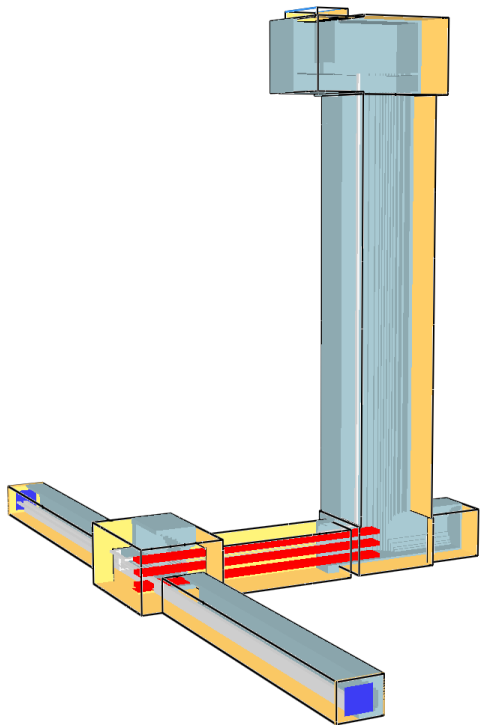
Examples of PBD applications at CERN

- PS: consolidation with complete renewal of smoke detection and extraction;
- SPS: fire consolidation (currently ongoing);
- FCC study: (international fire collaboration, virtual reality experiments);
- ISR: alternatives to fire compartmentalization defined through fire simulations;
- LINAC 3: fire and ventilation study supporting EN/CV;
- North Area: fire consolidation proposal defined through PBD;
- Fire resistance calculation of B. 245 roof structure;
- Fire risk assessment of the 400 kV substation in Prévessin;
- Etc.

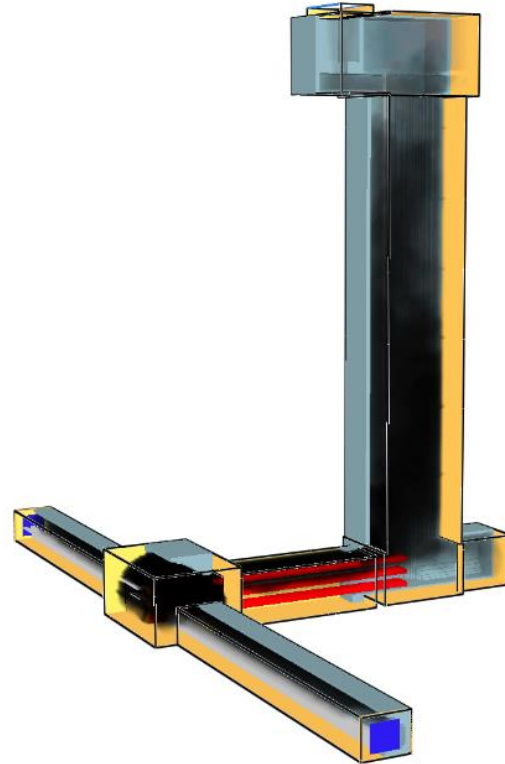


SPS fire consolidation

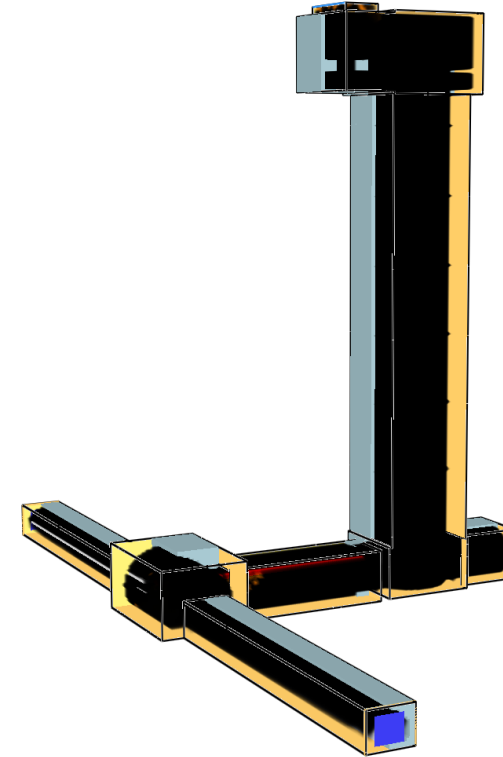
- Fire simulations showed smoke propagation in the access shaft already a few minutes after the fire ignition.
- Based on this risk assessment a fire consolidation project was started.



t=0min



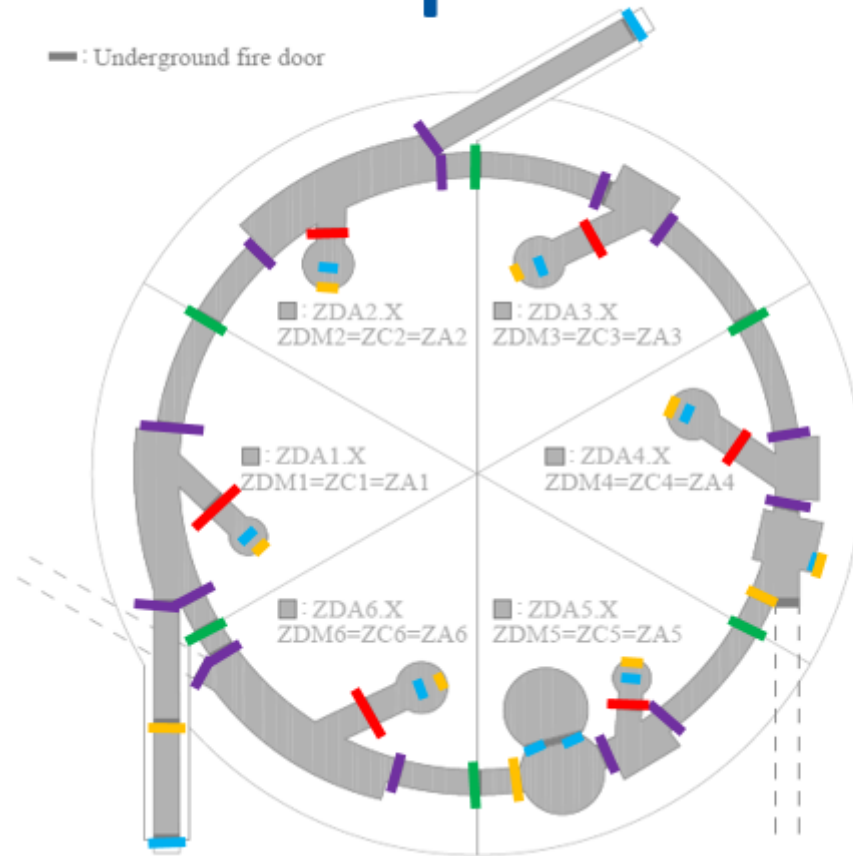
t=7min



t=30min

SPS fire consolidation

Fire compartmentalization



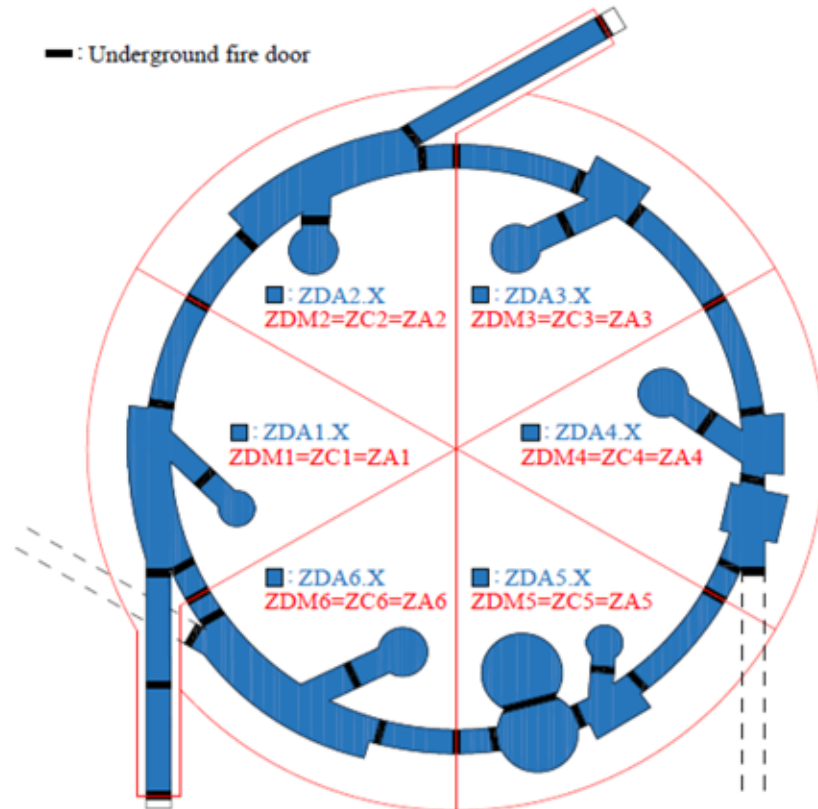
Compartments:
shaft
TA + LSS
arch to mid-sextant

Fire doors:

- 6 double level @TA
- 15 @LSS
- 6 @mid-sextant
- 14 @SPS boundaries
- 5 @other positions

SPS fire consolidation

Fire detection and safety action integration



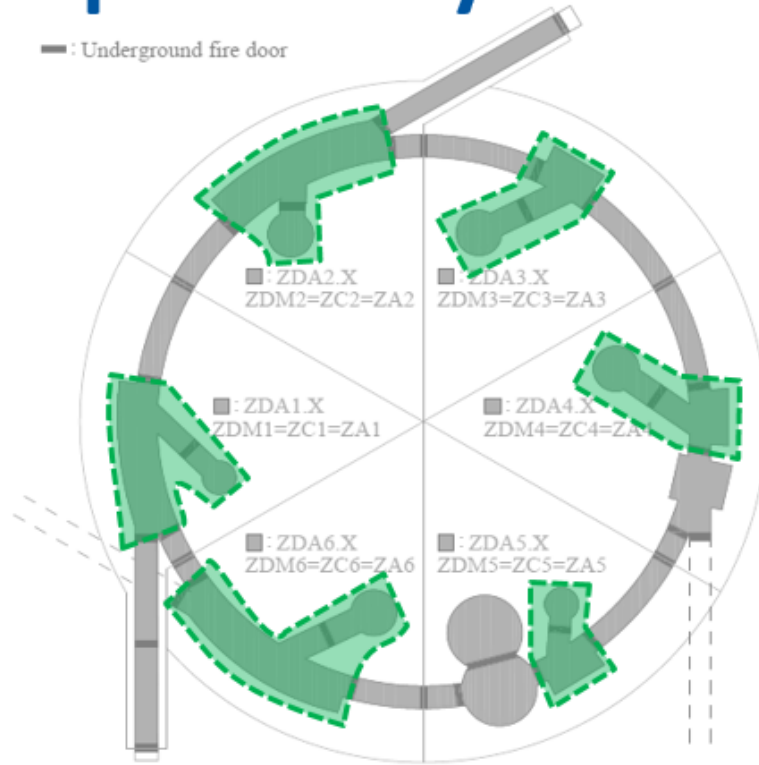
Air aspiration smoke detection covers **entire facility**

6 safety zones covering the **entire facility** for evacuation and compartmentalization

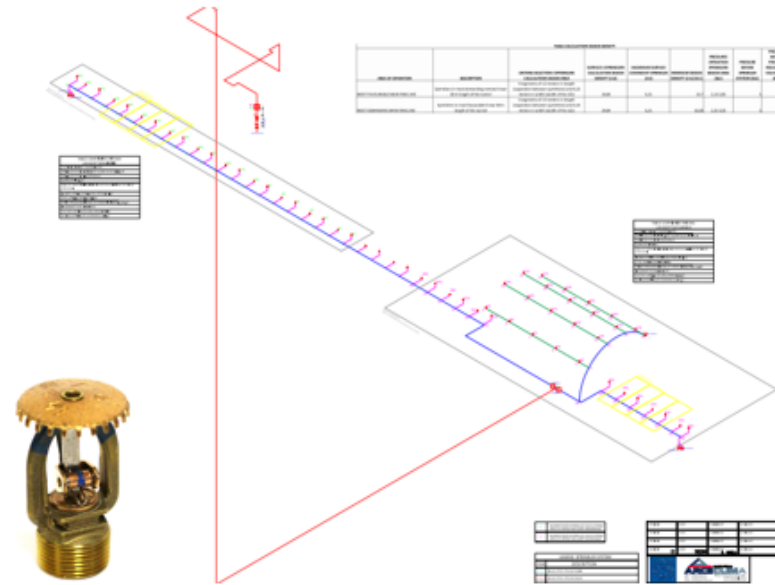
	ZC1	ZC2	ZC3	ZC4	ZC5	ZC6	ZA1	ZA2	ZA3	ZA4	ZA5	ZA6
ZDM1 or ZDA1.X	X						X	X				X
ZDM2 or ZDA2.X		X					X	X	X			
ZDM3 or ZDA3.X			X					X	X	X		
ZDM4 or ZDA4.X				X					X	X	X	
ZDM5 or ZDA5.X					X					X	X	X
ZDM6 or ZDA6.X						X	X				X	X

SPS fire consolidation

Sprinkler system

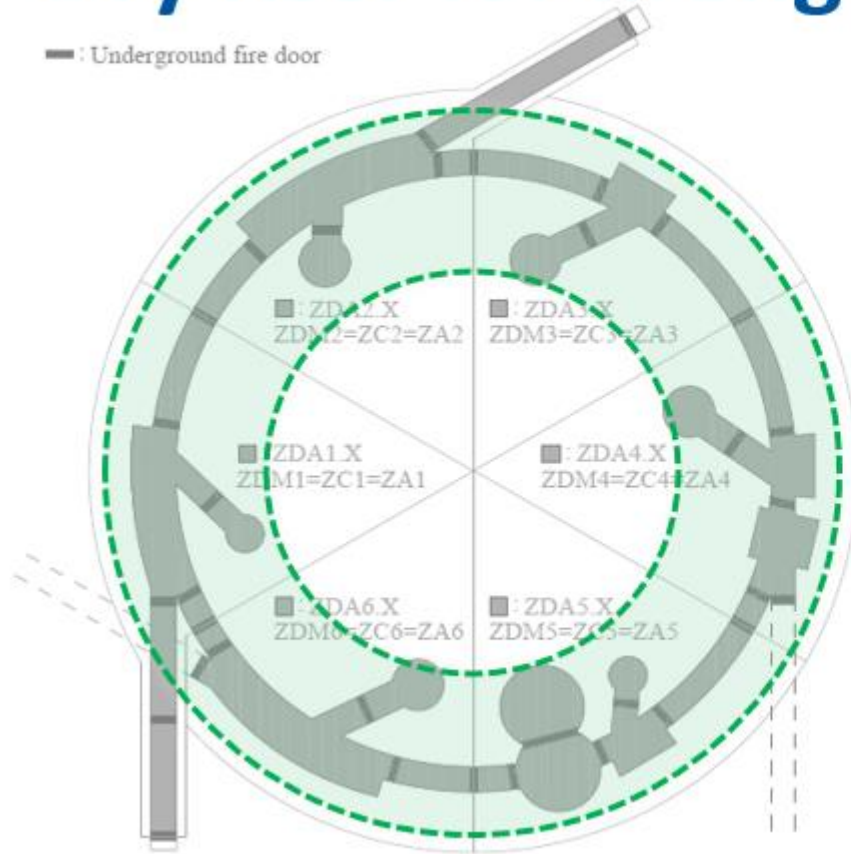


Covers shafts, TAs and LSSs

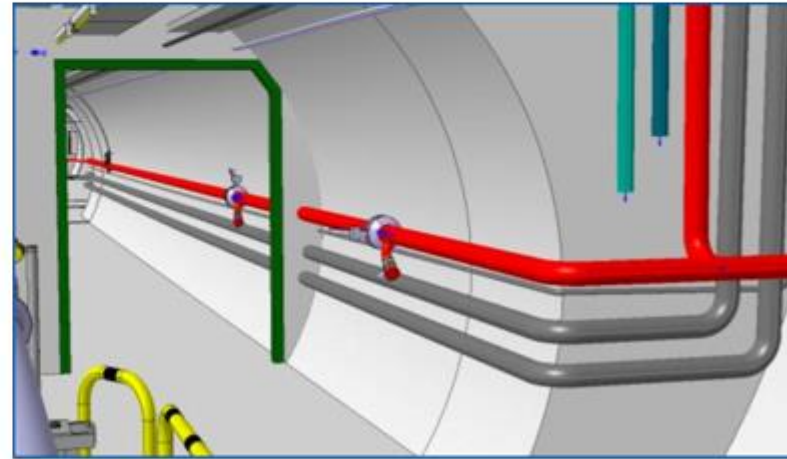


SPS fire consolidation

Dry riser for firefighter intervention

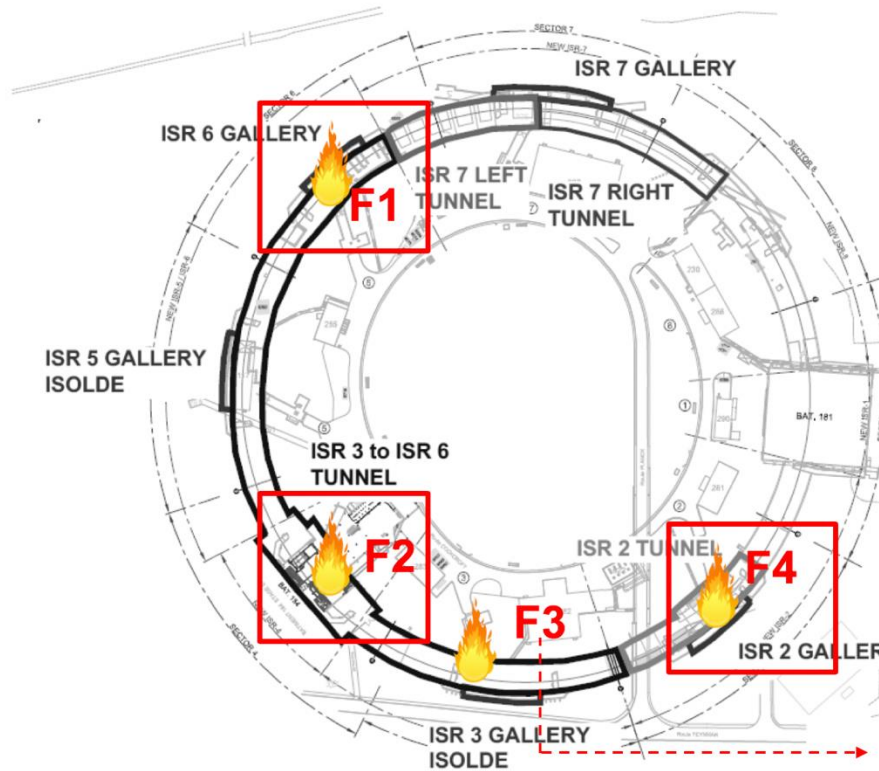


Dry riser covers **entire facility**
Dry by **default**, only filled with water in
case of intervention



Other Examples of PBD applications – ISR

Fire positions



F1 – ISR6, main tunnel

Smoke propagation $t = 900 \text{ sec}$

Without smoke curtains (current configuration)

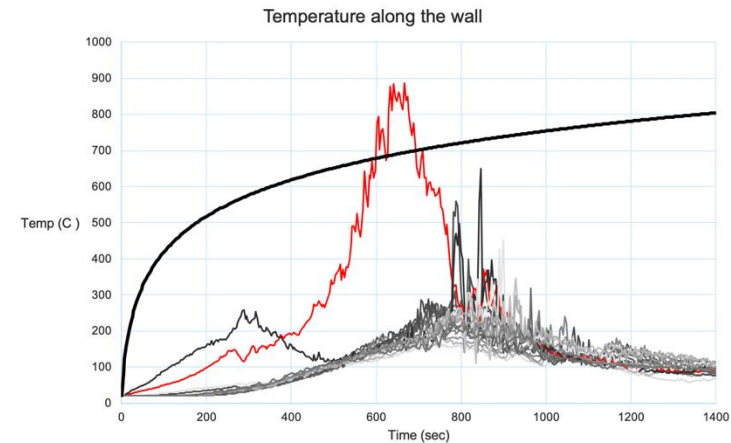


With smoke curtains



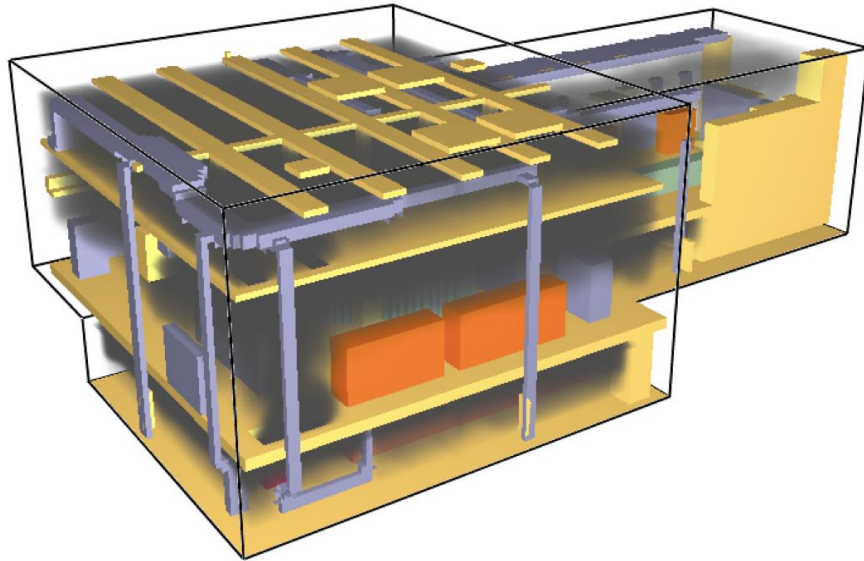
F4 – ISR2 / ISR 7

Fire resistance

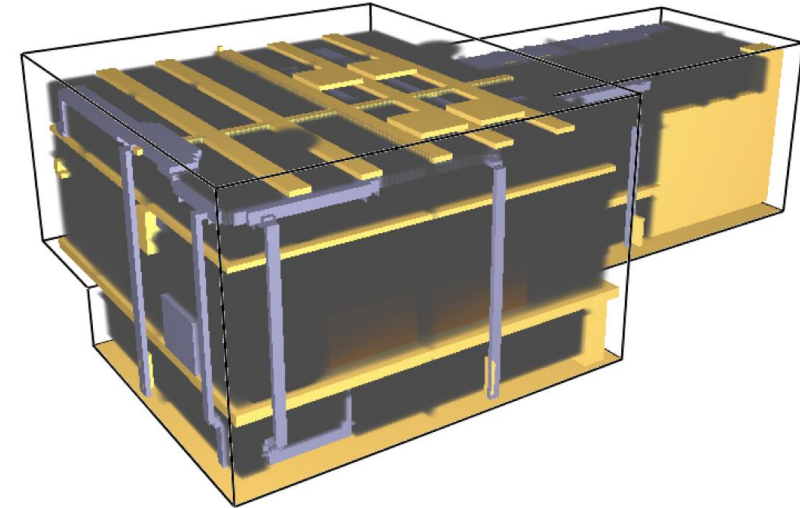


Other Examples of PBD applications – ISR

t=450s
end of evacuation

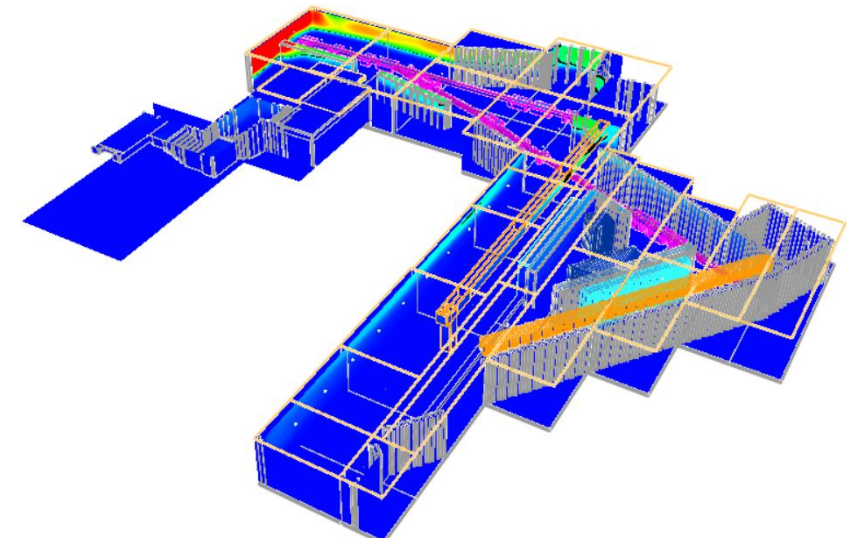
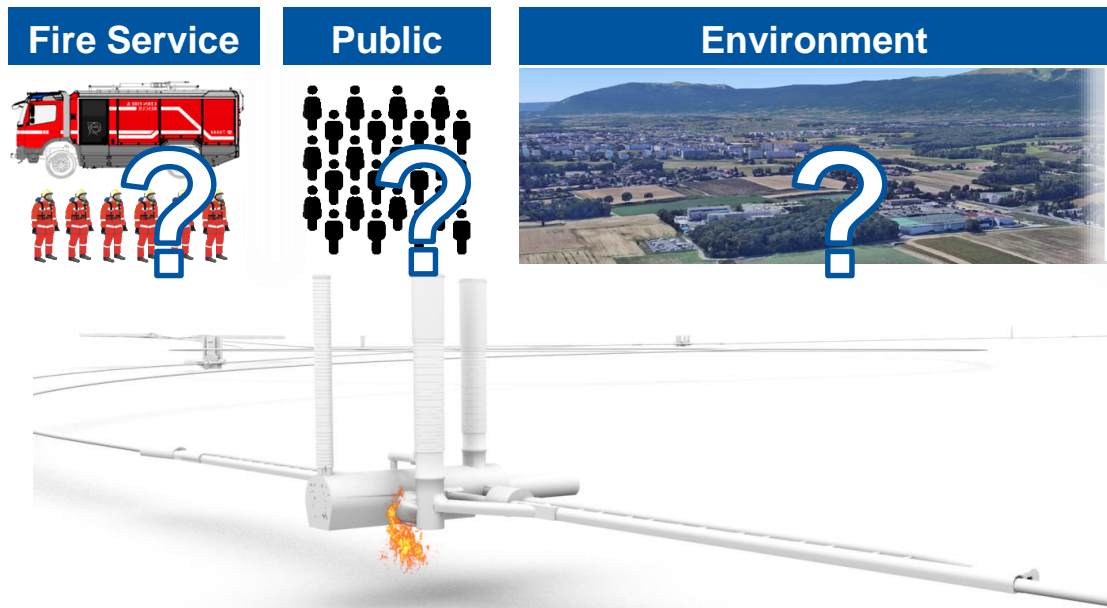


t=950s
FB on-scene
Smoke extraction starts



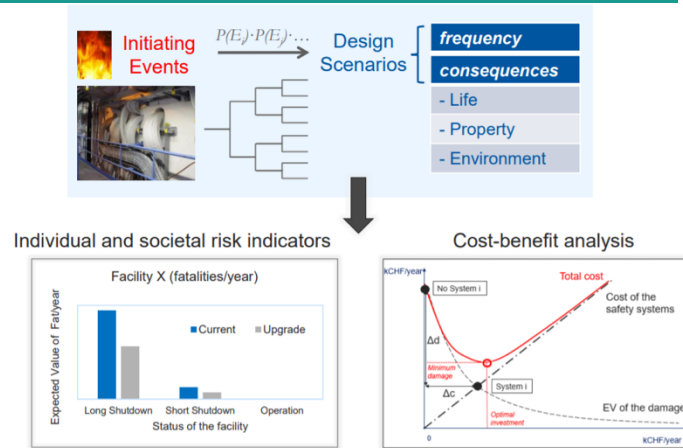
Fire safety challenges at CERN: Activation of combustible materials

- A probabilistic quantitative fire risk assessment including fire-induced radiological risk
- A long-standing unresolved issue at CERN (worldwide)
- A conservative approach was taken at CERN before FIRIA

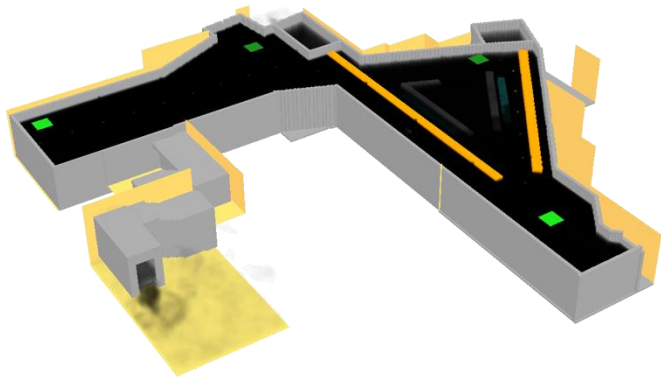


FIRIA project - ISOLDE pilot case

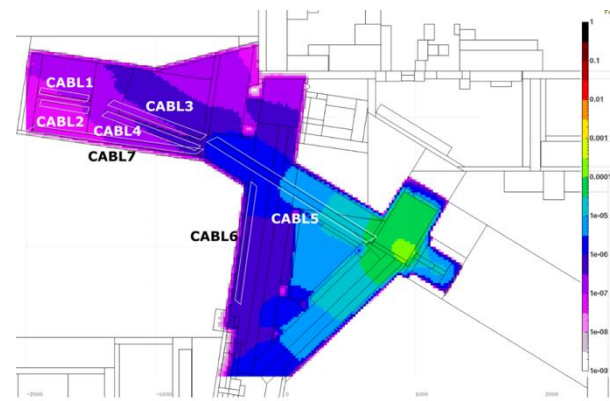
FIRE RISK ASSESSMENT



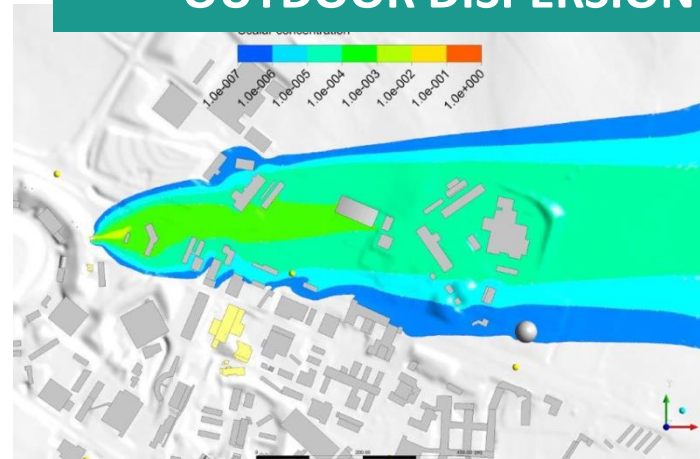
FIRE DYNAMICS



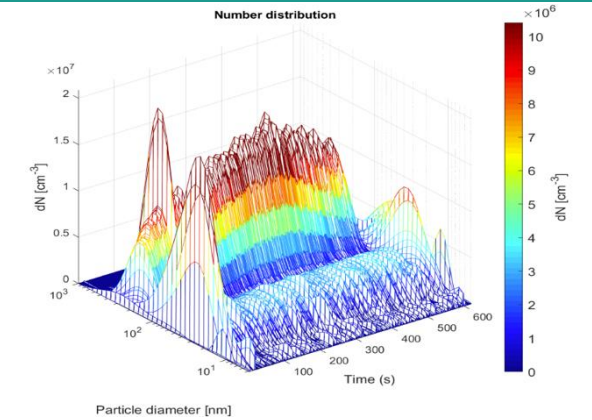
ACTIVATION OF COMBUSTIBLES



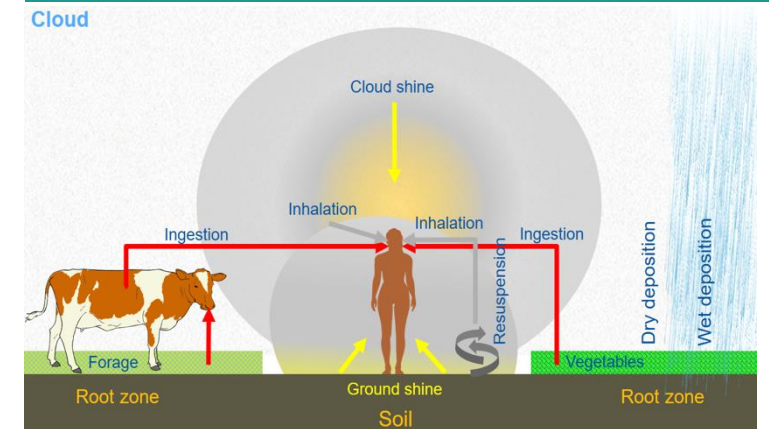
OUTDOOR DISPERSION



SOOT CHARACTERIZATION



DOSE CALCULATION





www.cern.ch