



HSE  
Occupational Health & Safety  
and Environmental Protection unit



# North Area (surface areas) B890 (BA81) Fire Risk Assessment

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EDMS 2464427

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# HSE deliverables

Risk Assessment

## North Area underground FRA

full fire risk assessment for the entire underground area

EDMS 1895523v1

## North Area surface FRA

lightweight fire risk assessment only for BA81

EDMS 2041630v1

Proposal

## Proposal for Fire Safety improvement

Summary of Prescriptions and Recommendations

EDMS 2135860v1

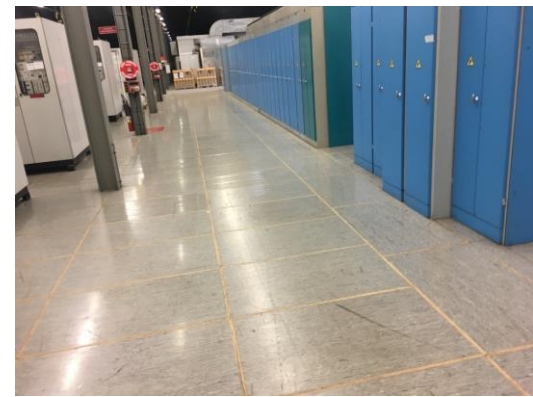
# Outline

1. Methodology
2. Scope
3. Global Safety Objectives
4. Fire Scenarios
5. Assessment
6. Conclusions
7. Proposal for improvement

# Methodology

- ❑ A **lightweight** fire risk assessment methodology is chosen to provide an **overview of the current fire safety situation of the surface buildings of NA.**
  
- ❑ representative buildings: **BA81** and EHN1
  
- ❑ **Hybrid approach:**
  1. compliance with **current prescriptive requirements** wherever possible
  
  2. expert judgement in a **credible worst-case scenario** when falling out of applicable codes.

# Scope: BA81 (890)



# Global Safety Objectives

## Life safety

Occupants shall be able to evacuate through protected areas, free from smoke and other hazards at any time;  
Victims and other occupants, not able to self-evacuate, shall reach protected areas, and wait there to be rescued by the intervention teams;  
Rescue teams shall be able to intervene safely and according to current CERN SOPs (acceptable engagement and fire attack distance, enough stability throughout firefighting operation of structures and equipment);

## Environmental protection

Limit the release of polluting agents to the environment (e.g. activated smoke in case of fire) in case of incident;  
Limit the volume of polluted (incl. activated) water released to the environment in case of incidents;

## Property protection

Structural loadbearing capacity is assured in case of fire and other incidents (no collapse);  
An incident shall not cause other potentially dangerous accidental events (e.g a fire shall not cause a helium release);  
Limiting the property loss in case of incident (e.g. in case of fire cleaning, recabling, replacing damaged equipment);

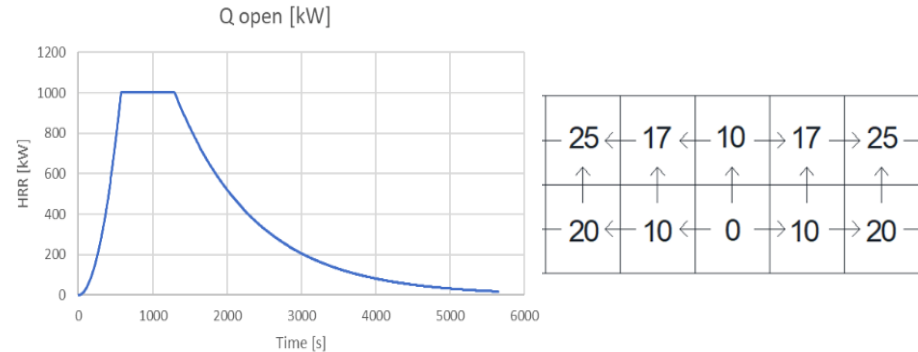
## Continuity of operations

Limiting the downtime in case of incident.

# Fire Scenarios

## Power converters

The majority of the power converters are arranged in blocks of 10 units, 5 units from each side, opened in the bottom to the false floor and in their upper part to the environment to provide a cooling airflow.



Derived from [1]

## Transient fuel loads



## Cable trays under the false floor



[1] Identification and characterization of design fires to be used in performance-based fire design of CERN facilities, EDMS 1985605, Darko Perovic, Lund University, Faculty of Engineering, Division of Fires Safety Engineering, Juin 2018



# Credible worst-case scenario

A credible worst-case scenario considers the most severe possible outcome that can reasonably be foreseen to occur.

For building 890 (BA81) the credible worst-case scenario is described as follows:

1. **Fire event** starting in a power convertor as a result of an **electrical failure or sparks** coming from **hot works**;
2. **Attempts** of building occupants to **put out** the fire do **not succeed**;
3. **Fire evolves** inside the electrical cabinet and molten plastic isolating materials **drip down** into the cable trays under the **false floor**;
4. **Fire propagates horizontally** along the cable trays;
5. **Ventilation airflow** pushes smoke and heat to **other power converters** from underneath.

# Assessment

## Evacuation

A number of critical safety elements for occupant evacuation are missing (not code-required\*) but highly recommended:

- Evacuation plan does not exist
- Evacuation routes are not marked (only exits)

According to CERN **Code E Appendix VI §2.2.2**, number of compulsory safety elements for occupant evacuation are missing:

- No sirens
- No alarm push buttons
- No link between fire detection and evacuation

## User extinguisher means

- Add extinguishers to fulfil the **CERN Code E Appendix VI § 3.2.2 requirement** (maximum distance of 10m to reach one fire extinguisher)
- Given the fuel load, fire attack with 2kg CO2 extinguishers is judged insufficient; 5kg CO2 handheld or 9kg CO2 on trolleys are judged to be more adapted

\*not required as low occupancy <50 and single story

# Assessment

## Detection

- Existing detection is judged sufficient to provide a reasonable fire detection delay. However, a **consolidation** of the existing **optic beam system** is **needed** due to **obsolescence**.
- Detection in false floor not present. Deemed **not essential for life safety** but **recommended** for property protection upon cost/benefit analysis.
- Cooling and **ventilation** systems may **contribute** to **fire propagation**, breaking the smoke layer and introducing turbulence due to the lack of **link between fire detection and ventilation**

## Smoke extraction

- Building 890 (BA81) is **not equipped** with a smoke extraction system. It would be nowadays required as  $A > 300 \text{ m}^2$ . A smoke extraction system **is deemed necessary to commit crews** for interior firefighting. Otherwise the tactical approach is likely to be defensive (let burn) with an inevitable aftermath of severe property damage.
- An automatic *natural* **smoke detection system linked to the fire detection** would contribute to maintain visibility and reduce smoke damage caused by soot deposition on electrical equipment.

## Fire Fighters Intervention

- If smoke spreads under the false floor and fills entire volume locating the seat and the extension of the fire becomes challenging
- False **floor Fire Resistance is assessed to be ~15min** for a fully developed fire → **Allow fire to burn it to ventilate**

# Conclusions

## For life:

- **simple measures to improve the evacuation strategy are deemed to be sufficient to reach acceptance**  
(evacuation sirens, alarm buttons and link fire detection to alarm)

## For property protection and continuity:

- **a full loss of the facility is an credible scenario**
- in case of willingness (user choice) to improve protection level a number of measures are listed as **recommended**  
(sprinkler, foam system and/or fire detection in the false floor)

# Proposal for improvement

## Summary of Prescriptions and Recommendations

EDMS 2135860v1

- Consolidation of existing fire safety systems is considered as granted.



**Note:** Updated form study report to Summary of Prescriptions

# Proposal for improvement (I)

## Summary of prescriptions and recommendations EDMS 2135860

ID	Assessment	Where?	Improvement measure
05	<b>Mandatory</b> for life safety	BA type buildings	Establish evacuation routes following the Safety Guideline “Evacuation Procedure and Principles for CERN sites in French Territory” EDMS 1815461v1.
06	<b>Recommended</b> for life safety	BA type buildings	Develop and implement an evacuation plan.
07	<b>Mandatory</b> for life safety	BA type buildings	Install evacuation sirens, alarm push buttons and link fire detection and evacuation alarm.
08	<b>Recommended</b> for property protection	BA type buildings	Reduce distance to reach fire extinguisher to 10m.
09	<b>Recommended</b> for property protection	BA type buildings	Replace 2kg CO <sub>2</sub> extinguishers by 5kg CO <sub>2</sub> handheld devices
10	<b>Recommended</b> for property protection (to undergo cost/benefit analysis)	BA type buildings	Link the stop of ventilation systems to fire detection.
11	<b>Recommended</b> for property protection (to undergo cost/benefit analysis)	BA type buildings	Fire detection in volume under false floor.

# Proposal for improvement (II)

## Summary of prescriptions and recommendations EDMS 2135860

ID	Assessment	Where?	Improvement measure
12	<b>Recommended</b> for property protection (to undergo cost/benefit analysis)	BA type buildings	Fire detection in air return inlet
13	<b>Recommended</b> for property protection (to undergo cost/benefit analysis)	BA type buildings	Install a smoke extraction system (natural ventilation preferable).
14	<b>Recommended</b> for property protection (to undergo cost/benefit analysis)	BA type buildings	Link smoke extraction system to fire detection.
15	<b>Recommended</b> for property protection (to undergo cost/benefit analysis)	BA type buildings	An automatic fire suppression system (sprinkler or high expansion foam) in the volume under the false.
16	<b>Recommended</b> for property protection (to undergo cost/benefit analysis)	BA type buildings	Prearranged openings to fill volume under the false floor with high expansion foam produced by CERN FB.
17	<b>Mandatory for life safety</b>	BA type buildings	BA type specific <b>intervention plan</b> . A broader scope intervention plan suited for BA typologies is also acceptable.
18	<b>Recommended</b> for life safety purposes.	BA type buildings	Optimization of existing fire protection systems. Should office blocks inside BA building be no longer in use, the air sampling fire detection system is judged excessive.

# Proposal for improvement (III)

## Summary of prescriptions and recommendations EDMS 2135860

ID	Assessment	Where?	Improvement measure
19	<b>Mandatory</b> for life safety	EHN type experimental halls	Campaign to rationalize excessive fuel load in storage areas, improve storage layouts and remove unnecessary combustible material. This is applicable to both permanent storage and transient fuel packages.
20	<b>Recommended</b> for property protection (to undergo cost/benefit analysis)	EHN type experimental halls	Extend smoke extraction system to areas not currently covered or only featuring a temperature control vent system.
22	<b>Mandatory</b> for life safety	EHN type experimental halls	Update existing and exercise the evacuation plan; develop and implement an evacuation plan in its absence.
22	<b>Mandatory</b> for life safety	EHN type experimental halls	Install evacuation sirens (different than BIW), alarm push buttons and link fire detection and evacuation a fire alarm system is absent.
23	<b>Recommended</b> for property protection (to undergo cost/benefit analysis)	EHN type experimental halls	Link the stop of ventilation systems to fire detection.
24	<b>Recommended</b> for property protection (to undergo cost/benefit analysis)	EHN type experimental halls	Link smoke extraction system to fire detection to ease intervention and avoid excessive smoke stacking.
25	<b>Mandatory</b> for life safety	EHN type experimental halls	EHN type specific intervention plan. A broader scope intervention plan suited for EHN typologies is also acceptable.
26	<b>Recommended</b> for property protection (to undergo cost/benefit analysis)	EHN type experimental halls	Fire compartmentalization in connections to TT81, TT82, TT84 and GHN3.



# Thanks Questions





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# Requirements

Requirement	Reference
<b>Generalities</b>	<p><u>French Code du Travail R4216-1 à R4216-4</u> :</p> <p>obligations du maître d'ouvrage pour la conception;</p> <p><u>French Code du Travail R4227-1 à R4227-3</u> :</p> <p>obligations de l'employeur pour l'utilisation</p>
<b>Escape routes</b>	<p><u>R. 4216-5 à R. 4216-12</u></p> <p><u>R. 4227-4 à R. 4227-14</u></p>
<b>Safety lighting</b>	<p><u>R. 4227-14</u></p> <p><u>Arrêté du 14 décembre 2011</u></p>
<b>Smoke extraction</b>	<p><u>R. 4216-13 à R. 4216-16</u></p> <p><u>Arrêté du 5 août 1992 – Section 2</u></p>
<b>Heating systems</b>	<p><u>R. 4216-17 à R. 4216-20</u></p> <p><u>R. 4227-15 à R. 4227-20</u></p>
<b>Storage of flammable materials</b>	<p><u>R. 4216-21 à R. 4216-23</u></p>
<b>Explosion risk</b>	<p><u>R. 4227-21 à R. 4227-27, R. 4216-31</u></p>
<b>Building materials</b>	<p><u>R. 4216-24 à R. 4216-29</u> (only for building h &gt; 8m)</p>
<b>Fire compartment</b>	<p><u>Arrêté du 5 août 1992 – Section 1</u> (only for building h &gt; 8m)</p>
<b>Surfacing materials</b>	<p><u>Arrêté du 5 août 1992 – Section 1</u> (only for building h &gt; 8m)</p>
<b>Firefighting</b>	<p><u>R. 4216-30</u></p> <p><u>R. 4227-28 à R. 4227-33</u></p>
<b>Alarm and fire detection</b>	<p><u>R. 4227-34 à R. 4227-36</u></p>
<b>Fire instructions</b>	<p><u>R. 4227-37 à R. 4227-40</u></p>

# General conclusions

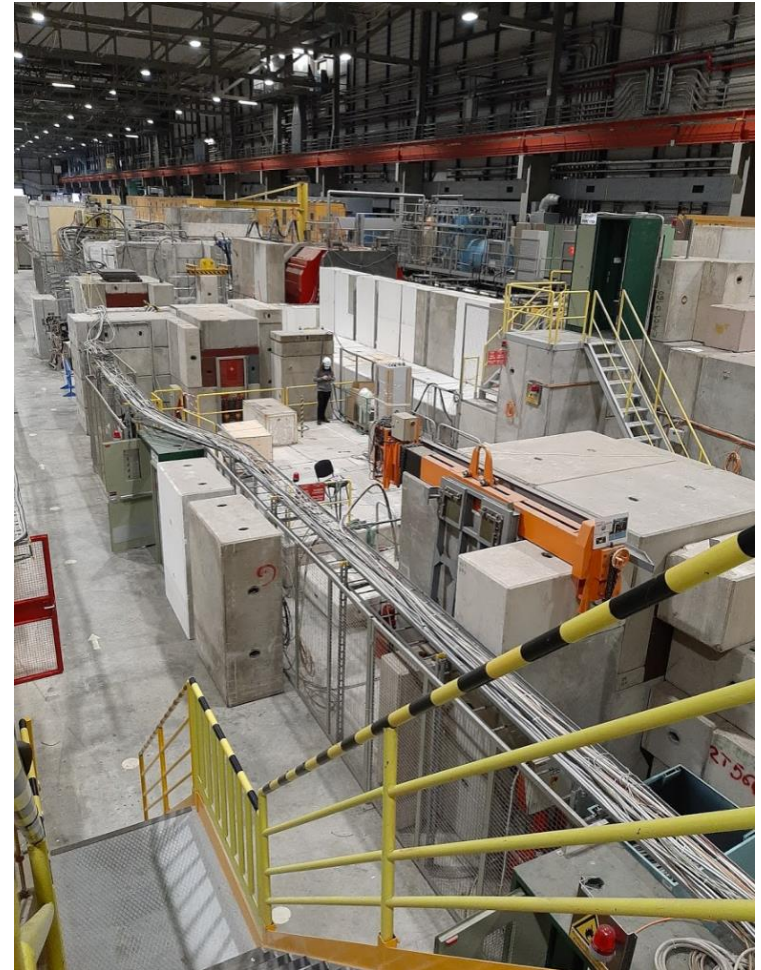
## For the NA underground:

- HSE came to similar findings of those in the SPS and prescribed **the SPS FIRE concept** for the protection of life, environment, property and continuity of ops.
- The SPS FIRE concept is also applied at BDF, HiLumi, FCC or CLIC.

## For the NA surface:

- **HSE prescribed some evacuation upgrades** (sirens, alarm buttons) for life safety.
- HSE **prescribed** a campaign to rationalize excessive fuel load in storage areas for life safety.
- HSE advised that full loss of a BA building is a plausible scenario and **recommended fire protection improvement measures for property protection** to be studied by risk owner.

# EHN1



# GHN300

