HSE
Radiation Protection

Radiation Monitoring at the North Experimental Area

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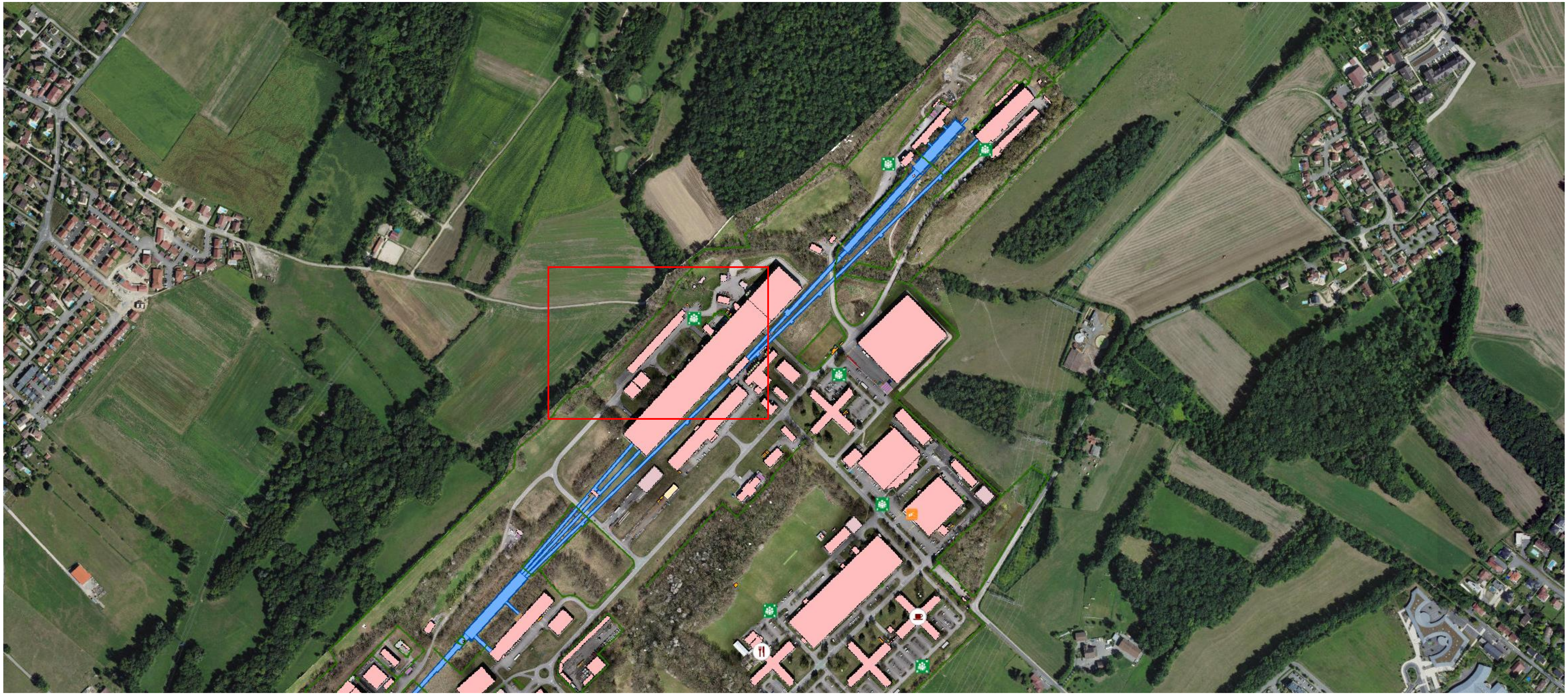
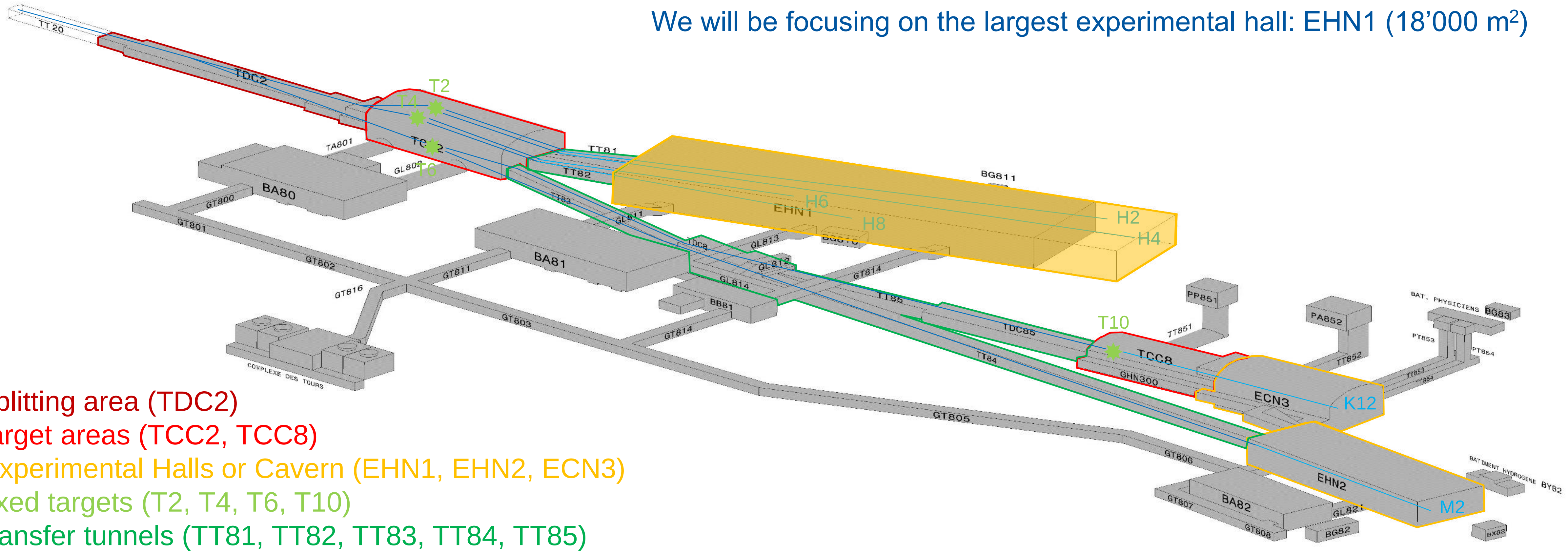
5th of December 2022

Geographical location



North Area Layout

We will be focusing on the largest experimental hall: EHN1 (18'000 m^2)



1 splitting area (TDC2)

2 target areas (TCC2, TCC8)

3 Experimental Halls or Cavern (EHN1, EHN2, ECN3)

4 fixed targets (T2, T4, T6, T10)

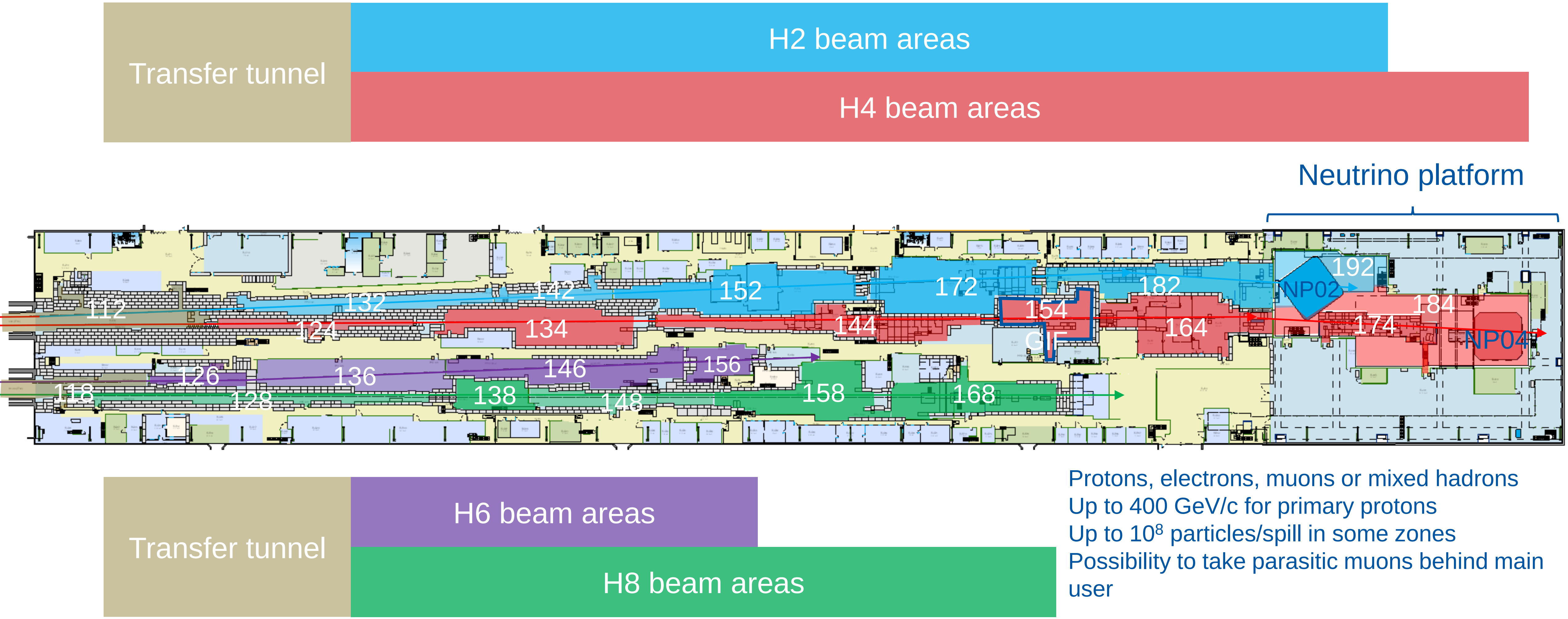
5 transfer tunnels (TT81, TT82, TT83, TT84, TT85)

6 experimental beam lines (H2, H4, H6, H8, K12, M2)

Around 7 kilometres of beam lines

Courtesy of S. Girod – BE-EA

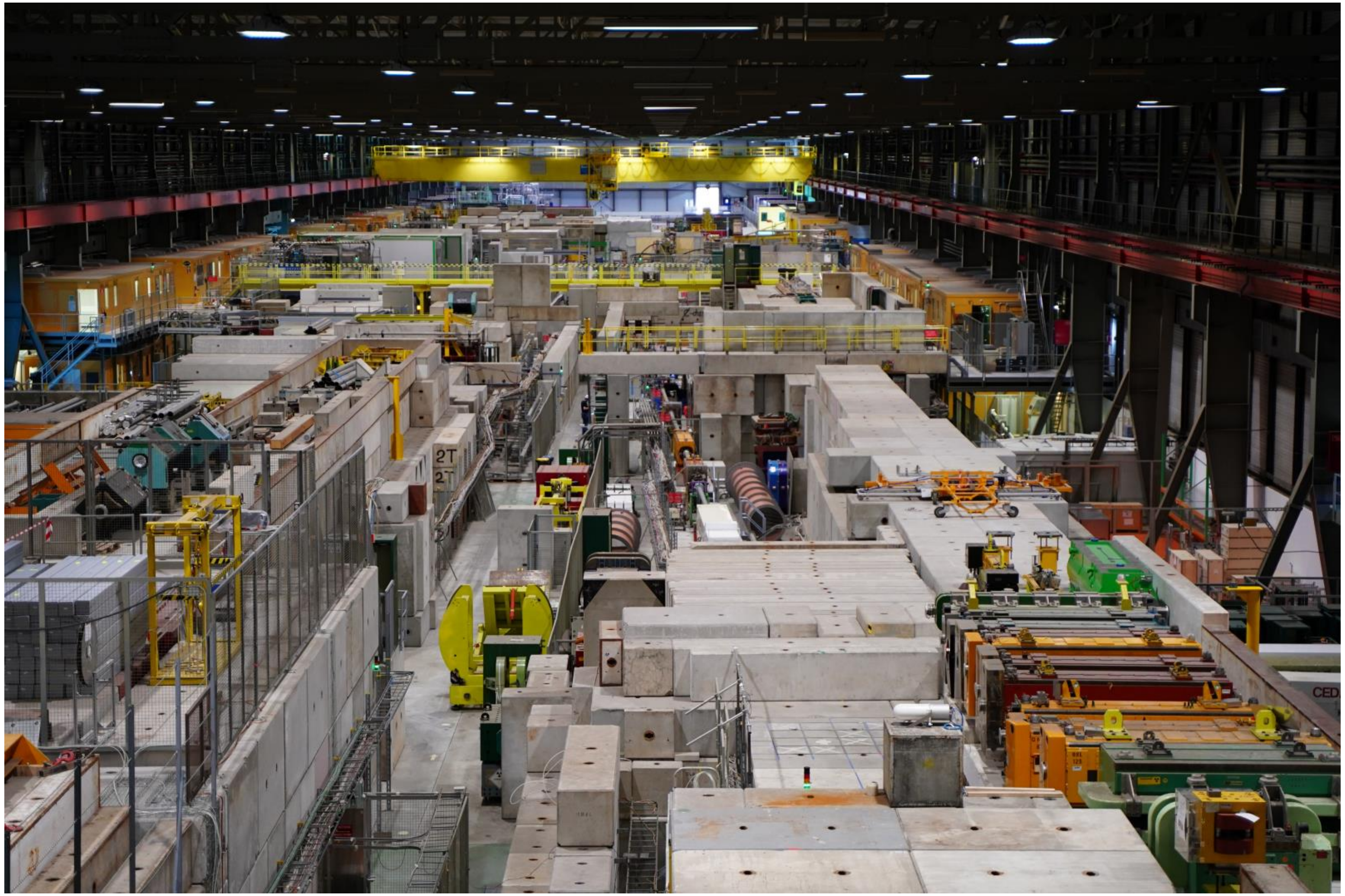
EHN1 Layout



Protons, electrons, muons or mixed hadrons
Up to 400 GeV/c for primary protons
Up to 10^8 particles/spill in some zones
Possibility to take parasitic muons behind main user

Courtesy of S. Girod – BE-EA

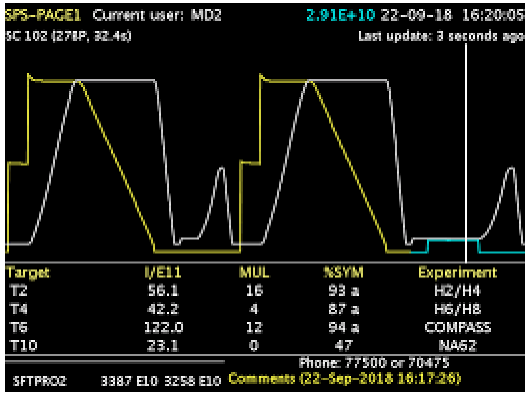
EHN1 picture

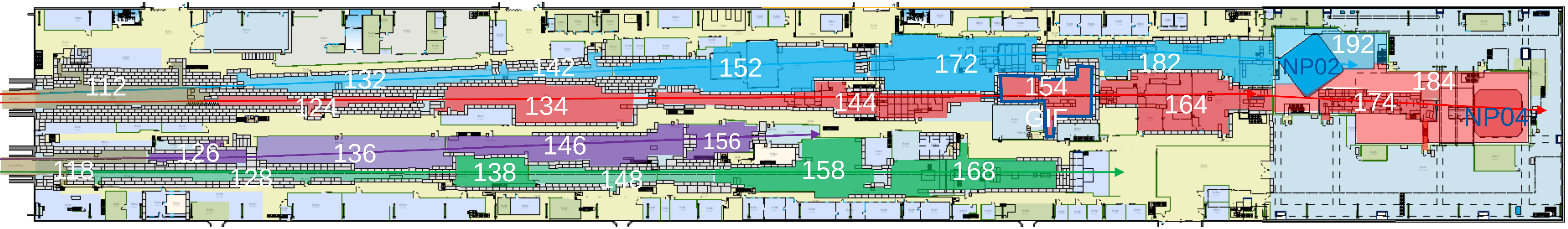


User Zones Layout

Spill structure from SPS

- 4.8s – 9.6s spill length
- 1 spill every 14s – 48s
- Spill length and repetition frequency depends on the number of facilities delivered by the SPS (North Area, AWAKE, HiRadMat, LHC)





User Zones are shown in colours
Main radiological risks are:

- Prompt radiation (in the whole experimental hall)
- Remanent radioactivity (in the transfer tunnels)

- High turnover of numerous experiments and R&D projects with different experimental setups and shielding configurations
- Zones are separated with movable 3.2m long iron dumps (XTDVs) surrounded by concrete

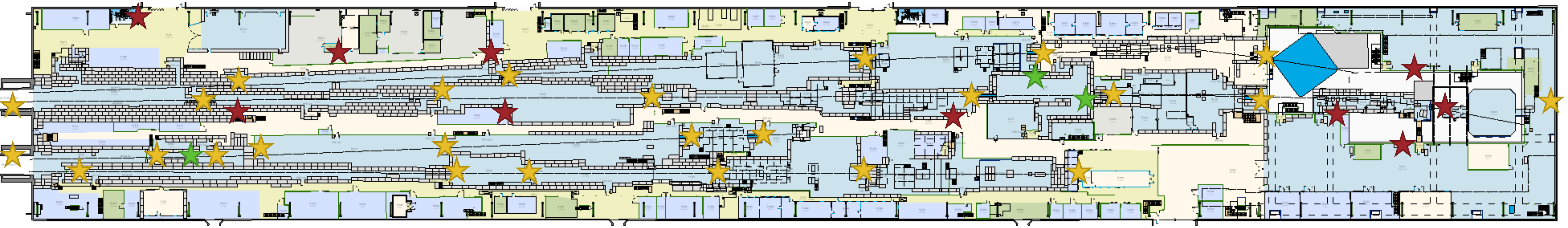
Radiation monitors layout

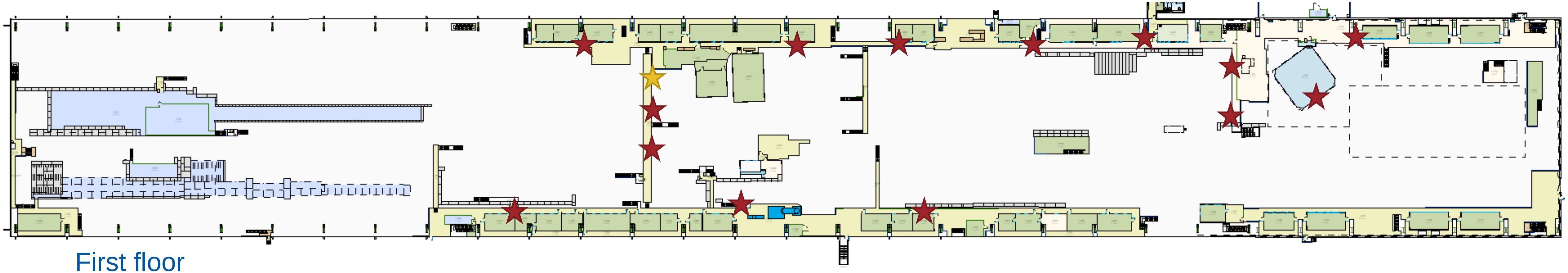
What's the logic for the monitors placement?

- 1 Argon chamber upstream almost every beam area
- 1 Hydrogen chamber near control rooms
- And assess all the particular cases

★ 27x IG5-A20 ★ 24x IG5-H20 ★ 3x IAM

Ground floor





First floor

Monitoring philosphy

Radiation Monitoring serves two goals:

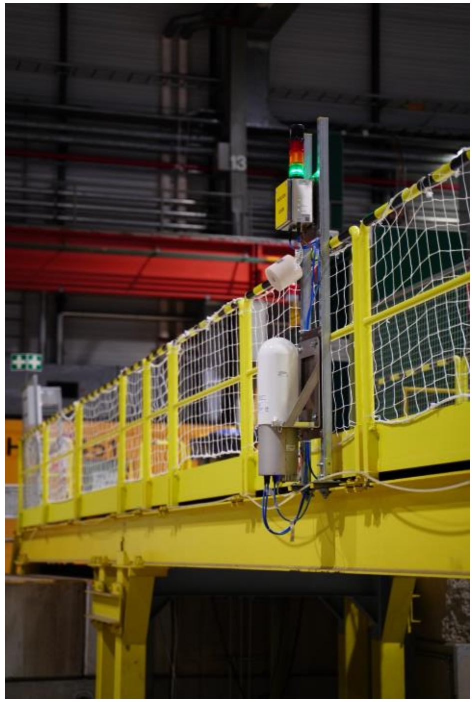
- Inform the personnel of higher radiation levels
    - Ensured by the CAU (CROME Alarm Units) integrated with the monitors
- Interlock the beam if radiation levels are too high
    - Ensured by the CJBs of EHN1 and the interlock equations

2 types of interlocks

- Unconditional
    - High level of radiation cuts the beam
- Conditional
    - If the beam area where the monitor is located is in access mode

  AND

    - if high level of radiation is detected, the beam is cut



Unconditional	Conditional
H2/H4 beam cut	H2/H4 beam cut
H6/H8 beam cut	H6/H8 beam cut

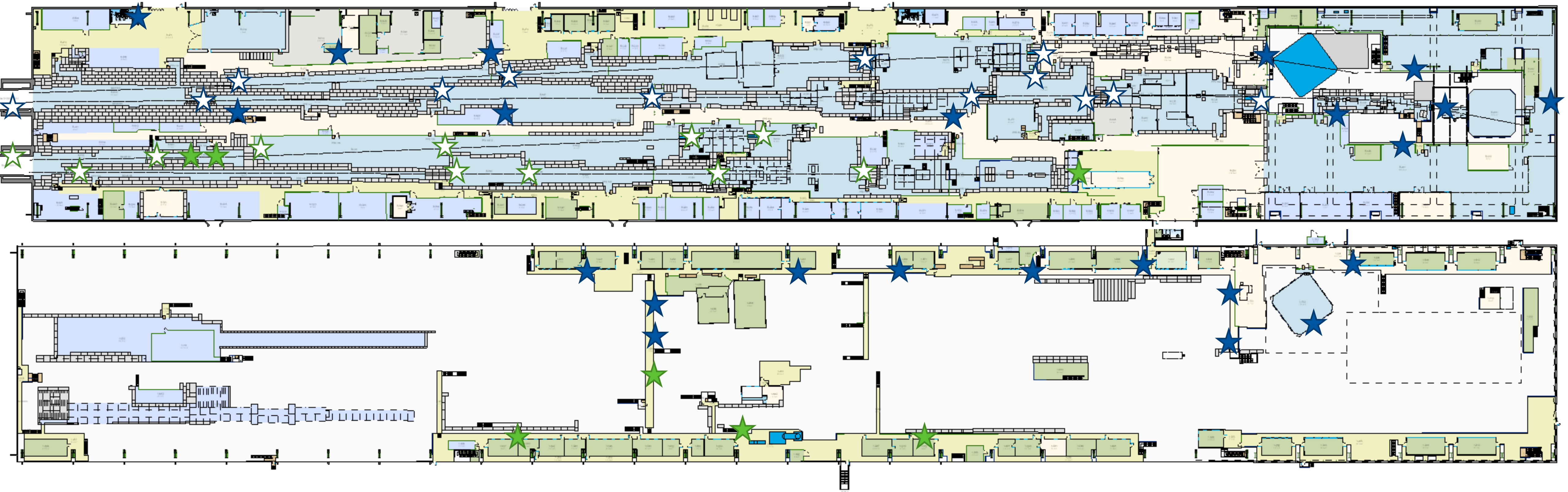
Radiation monitors layout

Unconditional	Conditional
H2/H4 beam cut ★	H2/H4 beam cut ☆
H6/H8 beam cut ★	H6/H8 beam cut ☆

Conditions examples:

Area 152 safe for access AND high alarm = Cuts beams H2

Area 112 safe for access AND high alarm = Cuts beams H2, H4, H6 and H8



Special cases

- High turnover of numerous experiments and R&D projects with different experimental setups and shielding configurations
- Due to this complexity, it is difficult to design a monitoring array that covers all setup configuration

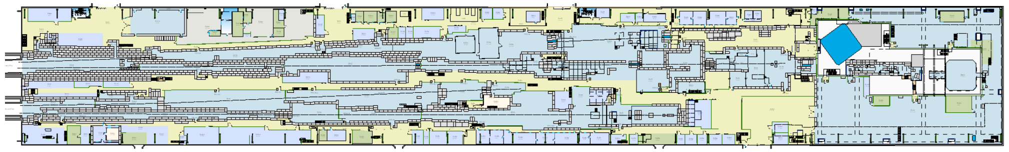
If the area is not well shielded, or presents some weaknesses, we need to find a solution

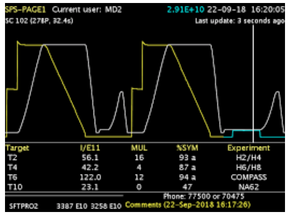
CROME Mobile measurement unit

Consists of two IG5 chambers (argon and hydrogen), audible alarm unit, battery pack, and data transmission to the REMUS supervision

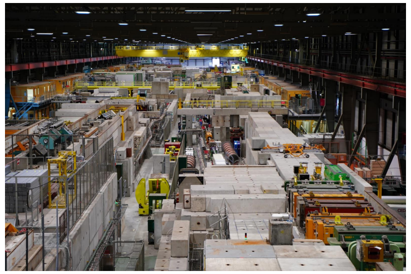
Summary

- Complex area
  - 6 beam lines, with several user areas
  - Various areas characteristics (shielding, beam elements, etc.)
- Complex monitoring array
  - Several types of radiation monitors needed
  - Beam frequency is variable
  - Beam characteristics are not constant
- Advanced interlock system
  - Need for a “tailor made” interlock system
  - Interfaced directly with the machine
- Special cases
  - Mobile monitoring devices can be used
  - Fully integrated with the supervision system





Area 112 safe for access AND high alarm = Cuts beams H2, H4, H6 and H8



Thank you

Questions?