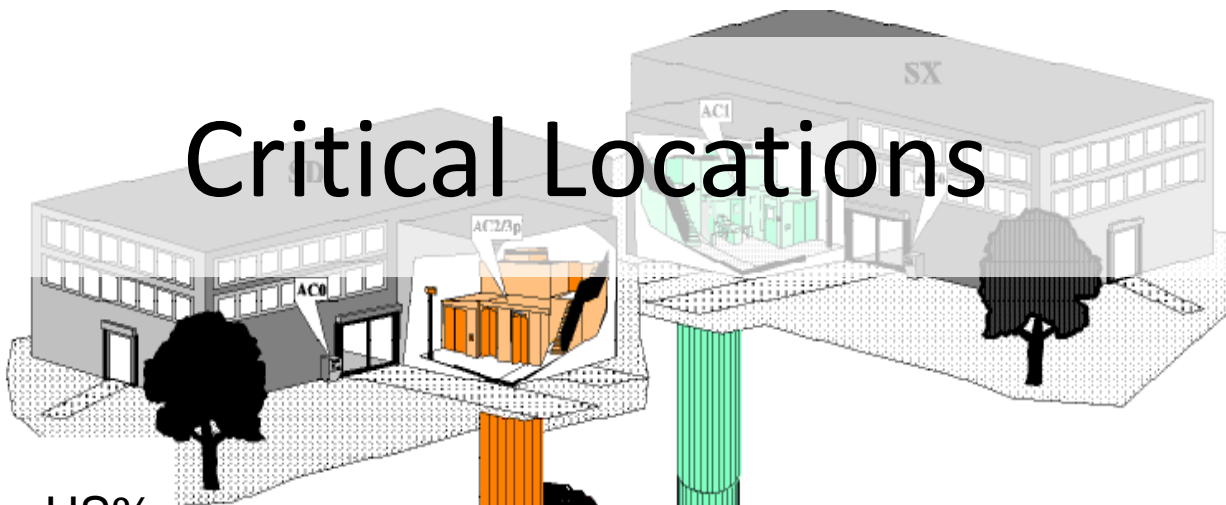




# LHC Critical Areas EN-EL equipment



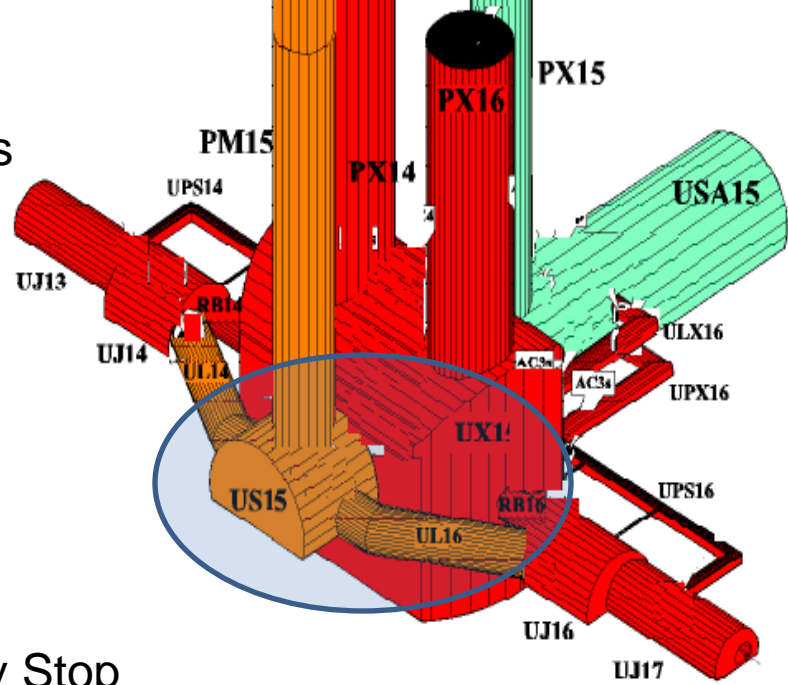
# Critical Locations



Safe rooms, US%,  
UA%, UJ56, UJ76,  
RE%

Experiment Caverns

Dry transformers,  
LV Switchboards,  
UPS, batteries  
48VDC sources  
General Emergency Stop  
Racks



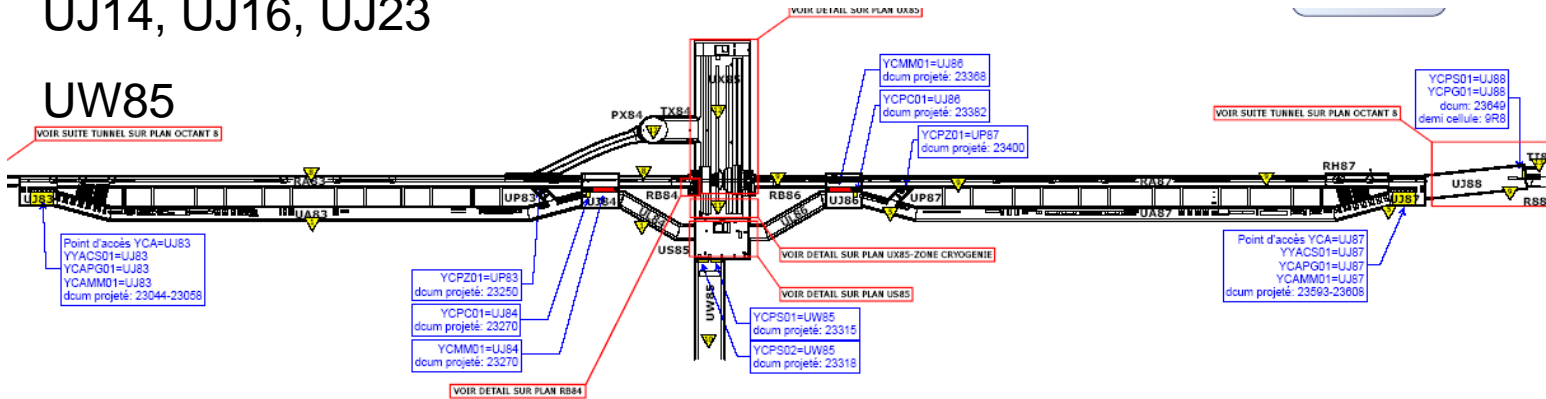
# Other Locations



RR%, UPS%

UJ14, UJ16, UJ23

UW85



Dry transformers,  
LV Switchboards,  
Emergency Stop Buttons  
Lighting

Tunnel:  
Emergency Stop  
Buttons  
Lighting  
Safety lighting  
F1, F2, F3, F4  
distribution boxes



# EN-EL Safe Rooms

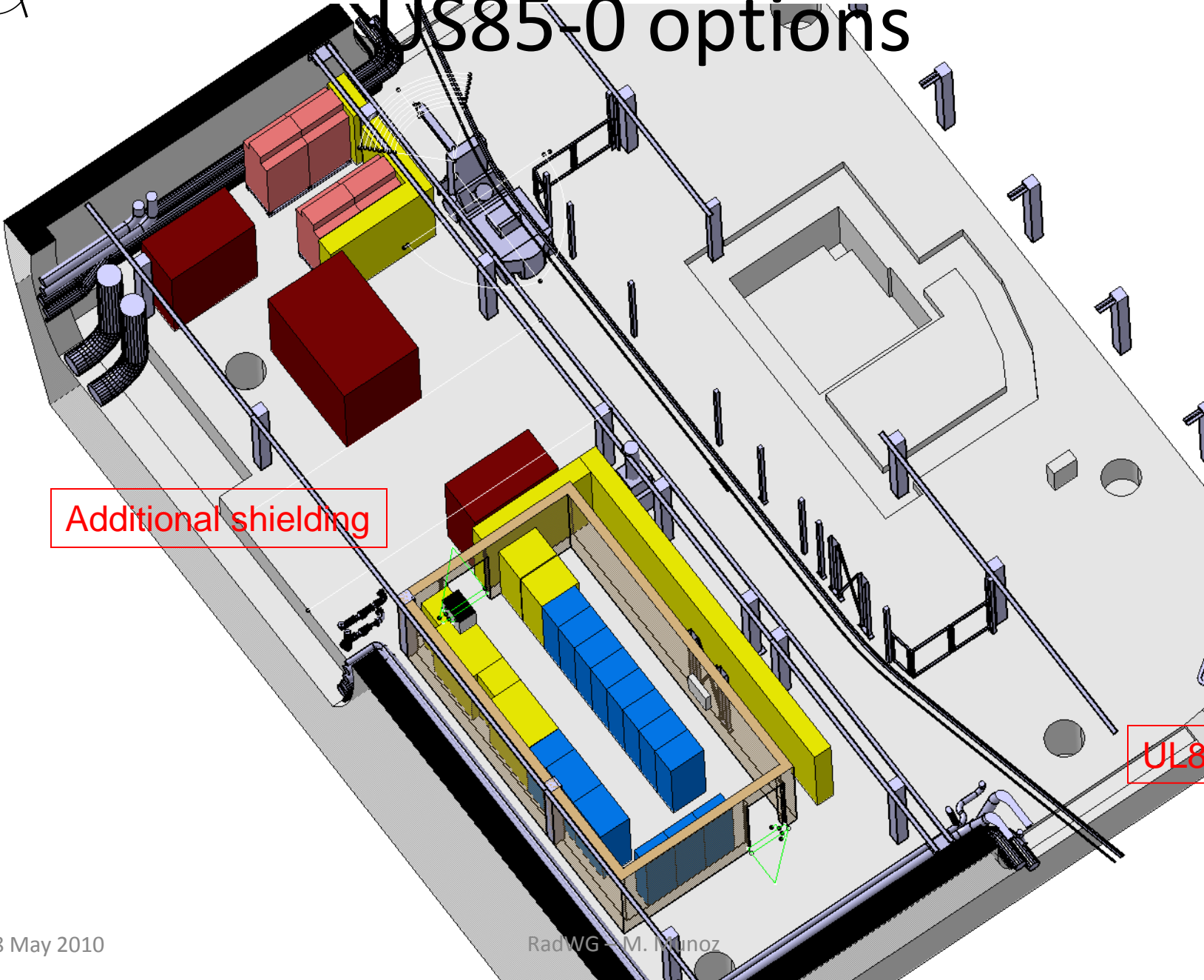


## Main equipment:

- General Emergency Stop Racks
- 48VDC sources, batteries and distribution crates
- UPS and UPS battery cubicles (except in UJ56, UJ76, US85)
- Low voltage distribution switchboards
- Racks with the equipment necessary to control and monitor the electrical equipment.
- Other services:
  - GSM
  - Fire detection
  - Red téléphone network...



# US85-0 options



Additional shielding

UL8



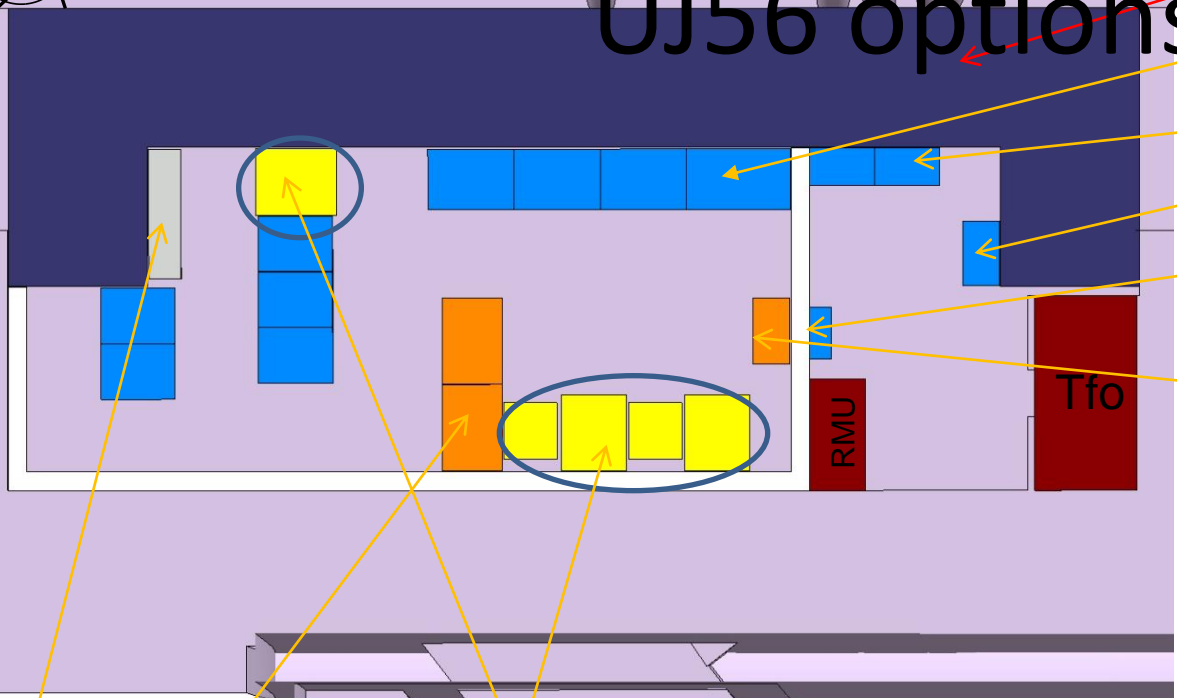
# US85-1 relocation

- Four UPS units (machine and cryogenics) → UA.
  - Sensible to radiation since their logic depends on transistors, CMOS, IGBTs, microprocessors and other electronics.
- EYQ% rack with cryogenics 24VDC generation.
  - 24VDC PROMEC modules with electronic components sensible to radiation (EPROMs, diodes, MOS, microprocessors, transistors...) powering cryogenics control PLCs.



# UJ56 options

Shielding: 1.5 m



EBD1/56

EAD1/56

EBD2/56

EAD2/56

ESD2/56

RMU

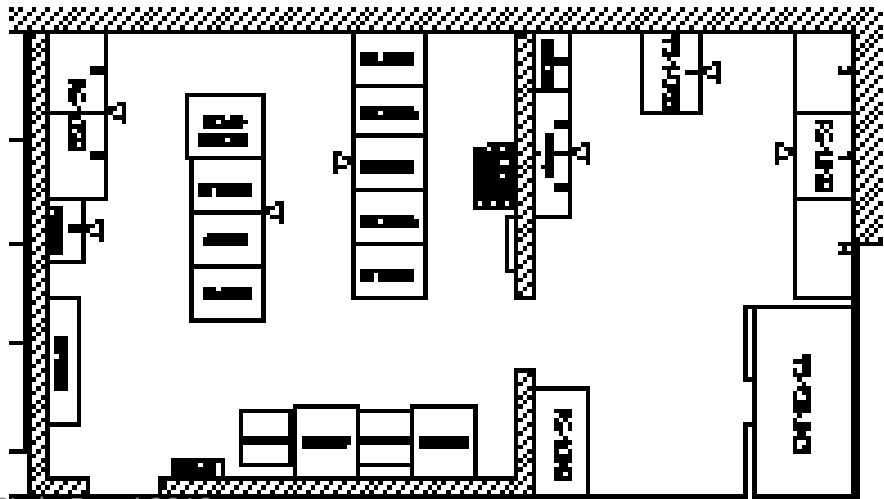
Tfo

**Solution 1:**  
**If equipment can stay**

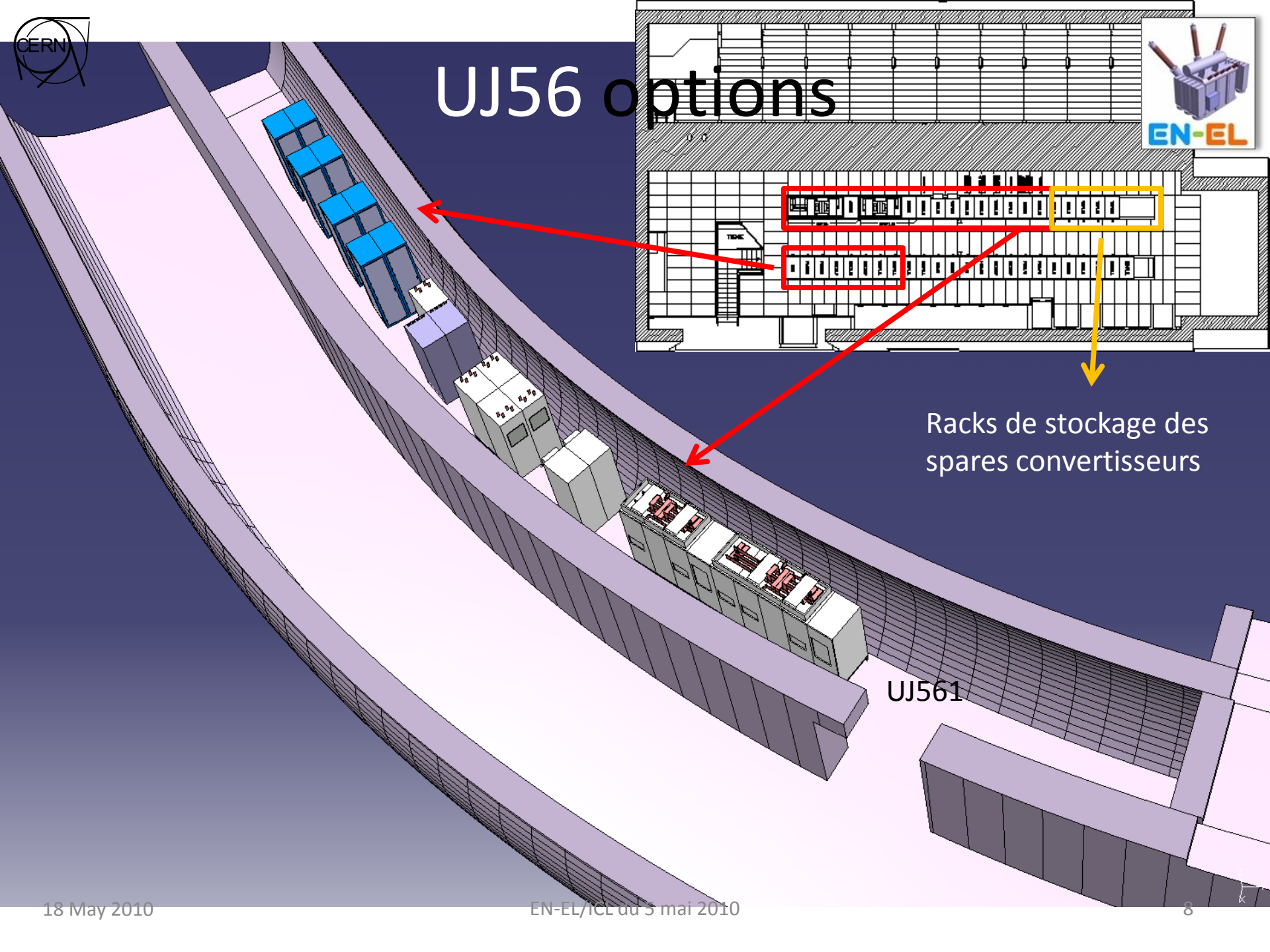
EOD1/56 ESD1/56

48V

AUG Rack, LV Switchboards,  
48VDC Distribution



# UJ56 options



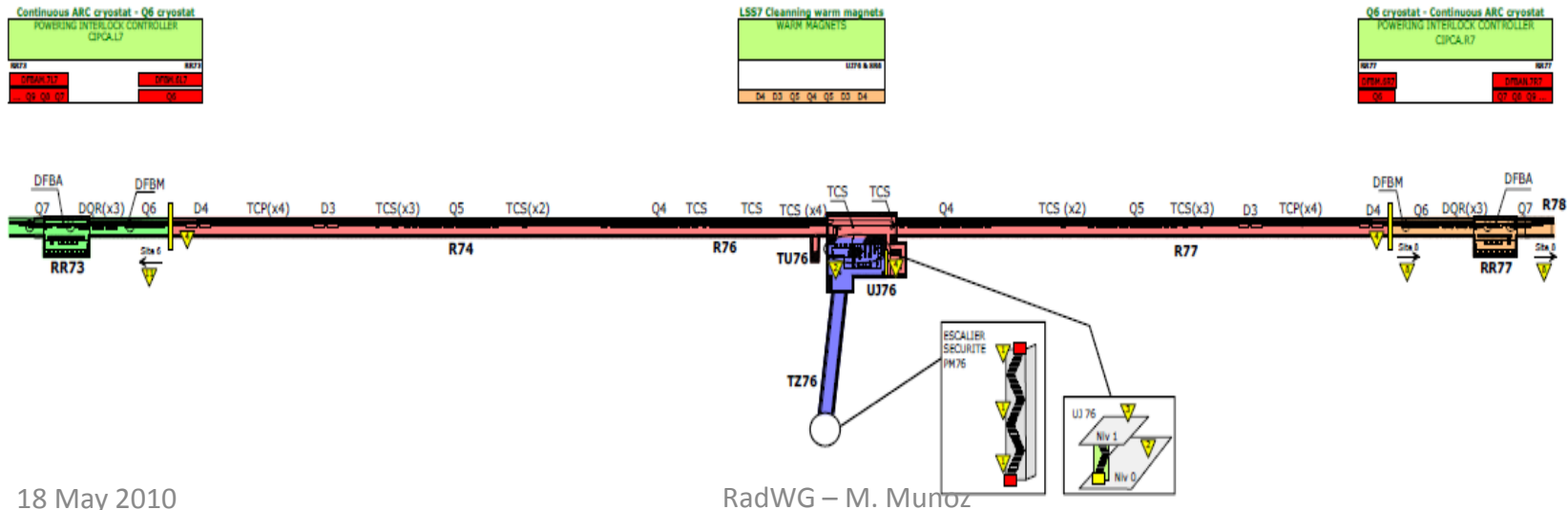
Racks de stockage des spares convertisseurs

UJ561



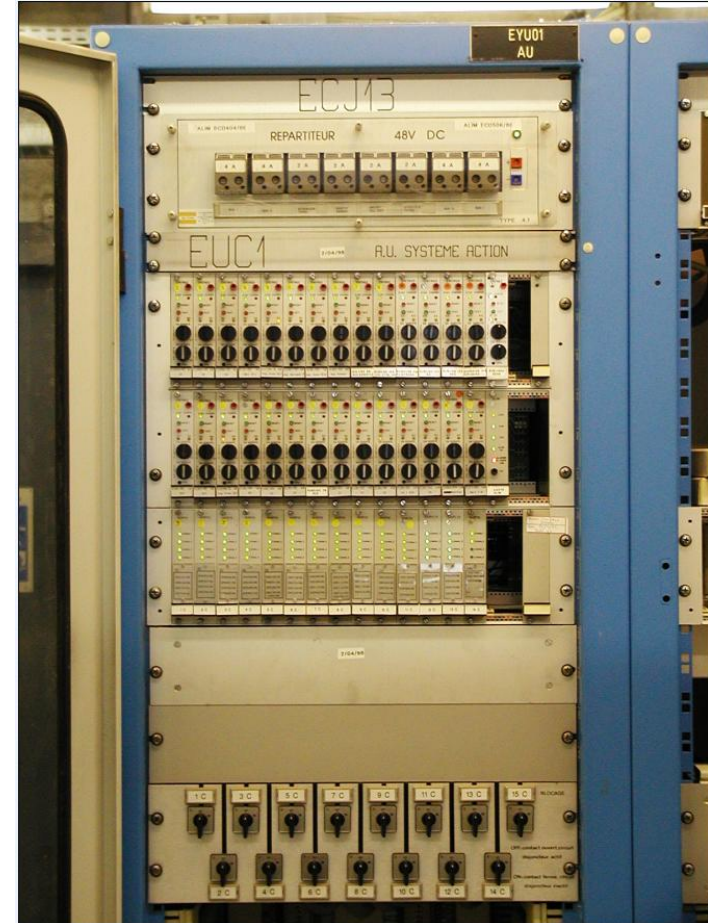
# UJ76 relocation

- UPS' relocated to TZ76.
- Fenced Safe room: EBD, EAD, RMU, Transformer
- Concrete Safe room: AUG, 48VDC, EOD, ESD.



# General Emergency Stop Racks

- PCBs with the logic for the AUG safety functions.
- I/O cards, capacitors, diodes and integrated circuits.
- The safety logic is done via contacts and relays that in principle should not be affected by radiation (LEP equipment).
- Determine behaviour in presence of radiation → Monitoring?



# 48VDC Sources

- Placed in safe rooms + RE%.
- Ackermann manufacturer. Redundant chargers.
- Power electronics and sensible components such as zener diodes, transistors, PCBs with integrated circuits, thyristor bridge and PLC.
- If charger fails → battery backup.
- Lost of 48VDC → AUG, ENS, HV protections, LV distribution, safety lighting
- Determine behaviour in presence of radiation. Monitoring?



# LV Distribution Switchboards



- Power general services, CV, cryogenics, power converters, and LV distribution.
- Fuses, bornes, switch breakers...
- Electronics existing in some protections tripping devices.
- Micrologic in the tripping devices.
- Radiation effects either make the protections to switch off randomly or not to switch off at all, which might have important consequences in case of short-circuit or overload.
- Monitoring equipment and displays (DIRIS). No safety function, not right measurements or temporary supervision lost.



# Electrical Network Supervisor



- They are vital for our monitoring systems. These racks could be very sensible to radiation.
- Racks contain all of the equipment necessary to control and monitor the electrical equipment:
- DAUs (data acquisition units)
- RTUs (remote computers), microcontrollers, switches, ethernet...
- Possible radiation tests.



# Radiation deterioration ?

- Medium voltage transformers whose isolation “resine” (organic material) might decompose in the long term with radiation.
- Battery racks. Not affected by SEE. Deterioration?
- General Emergency Buttons. Plastic component that is deteriorated by radiation → button might set an AU safety function off. Safety of people is ensured.

Annual tests of the AU system are carried out and campaigns of replacement of these AU buttons are foreseen.

