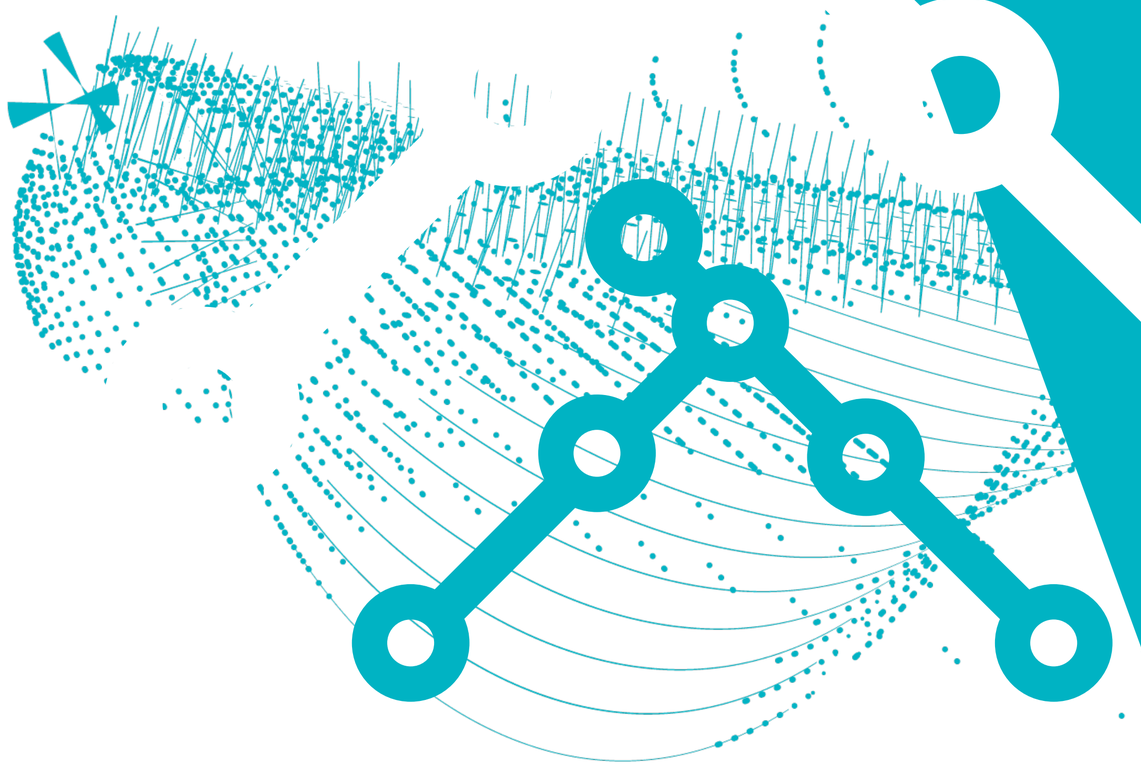
Nikhef



ET Pathfinder workshop: Infrastructure
3rd of June 2025

Outline:

- Main power distribution
- Safety
- Cable ducts
- Power your system

On behalf of the ETpf group

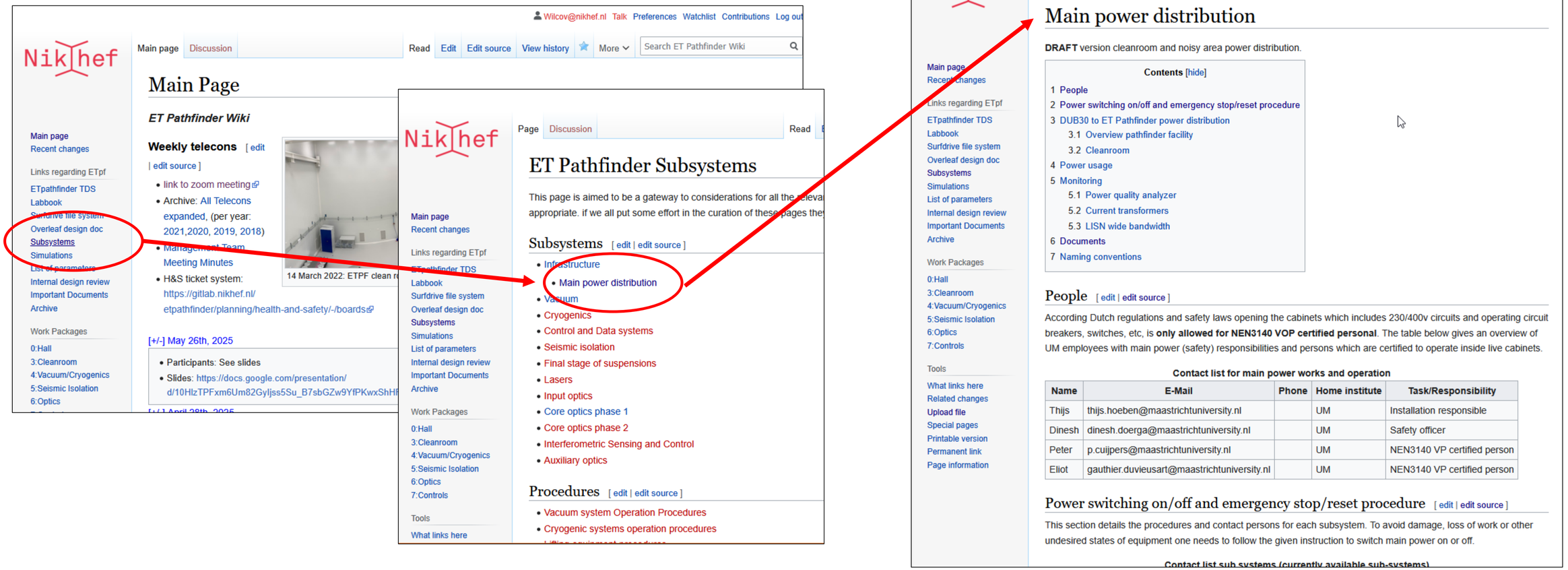
Main power distribution clean room & noisy area

What has been done:

- Inventory
  - Sub-systems
  - Requirements
- Multiple negotiated order
  - Orders 50k-220k Euro
- Installation by Jansen
  - Updates only by Jansen
- Certification by Equans
  - NEN1010 compliant
- Documentation
  - Wiki
  - https://wiki.nikhef.nl/etpathfinder/Main_power_distribution

Main power distribution clean room & noisy area

Documentation



Power distribution overview DUB30

DUB30
Building C
435kVA

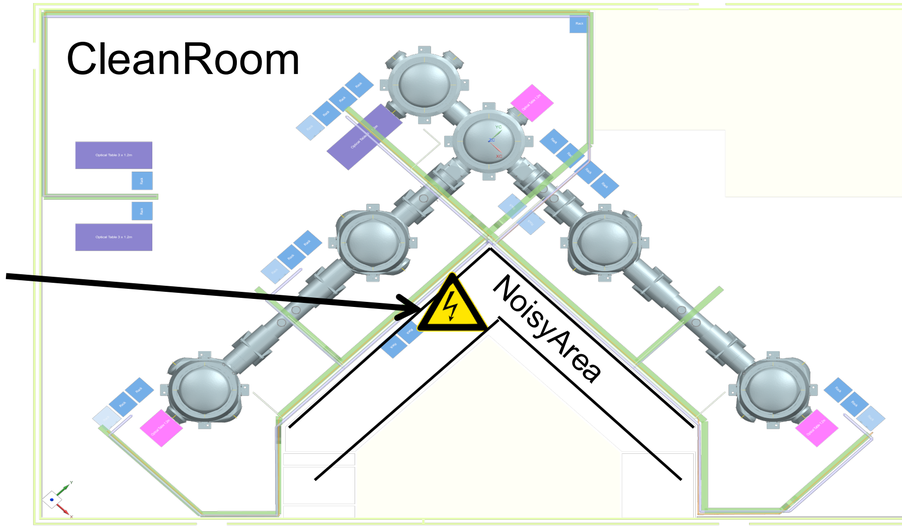
Main power connection
at the visitors area
250kVA

HVAC; Cleanroom climate control

Power connection
noisy area
180 A = 125kVA

Equipment clean room

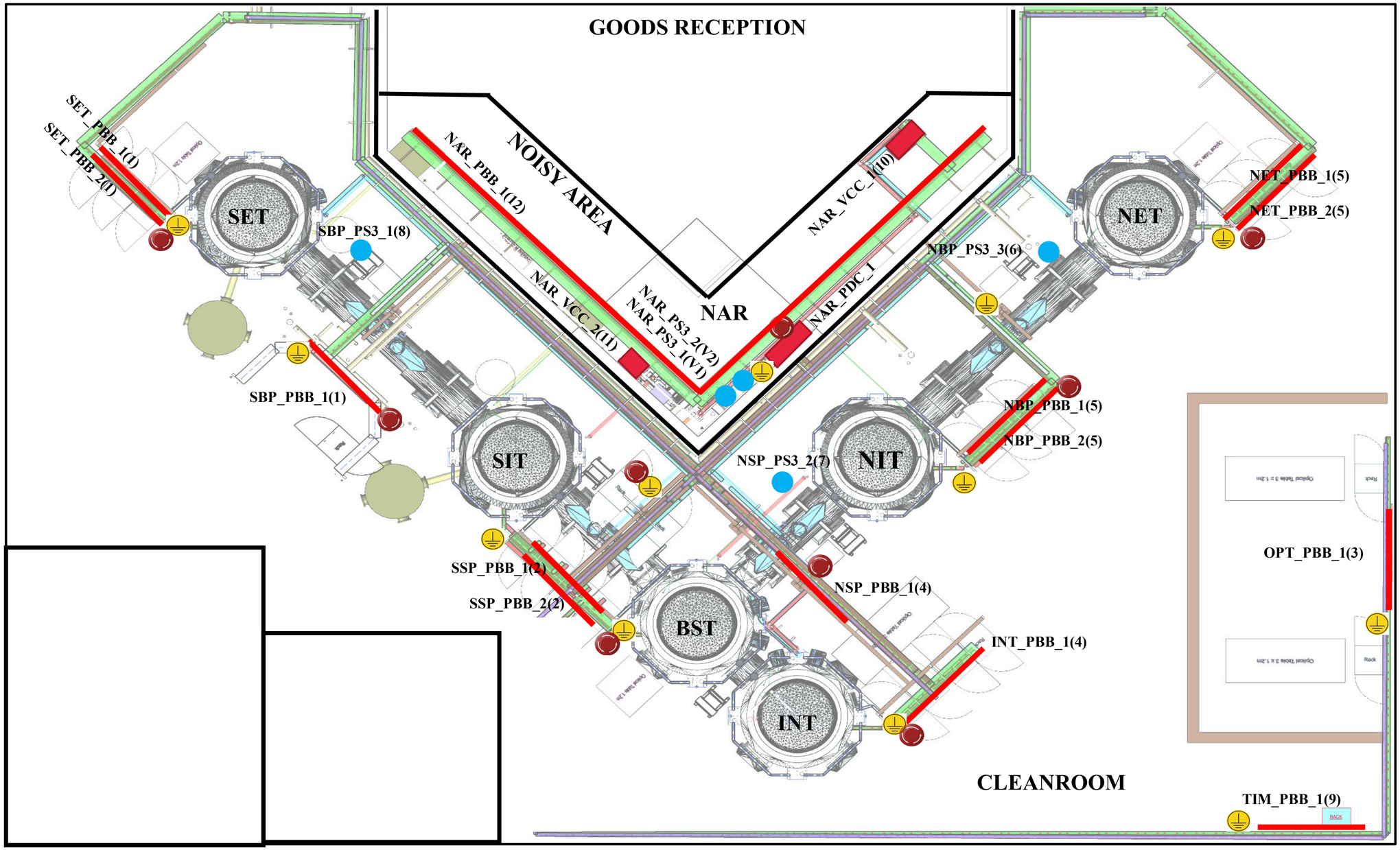
Equipment noisy area



How to get equipment powered?

- Various options to distribute mainpower
- Combination of three options are available:
  - Default → busbars
    - Standardized “flexibel” system
    - Schneider Canalis KN 63A
    - Installed at various locations
  - Directly connected
    - Exeptional option for high power demanding equipment
  - Wall outlets
    - Temporary usage, e.g. hours to days

Floorplan



LEGENDA:

BUSBAR:

POWER SOCKET:

EMERGENCY STOP:

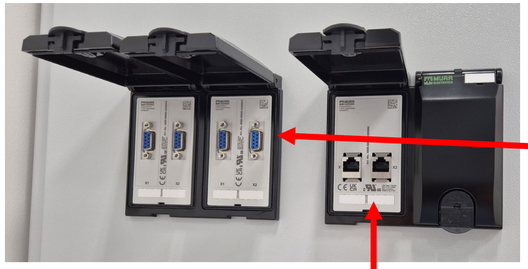
EQUIPOTENTIAL BONDING STRIP:

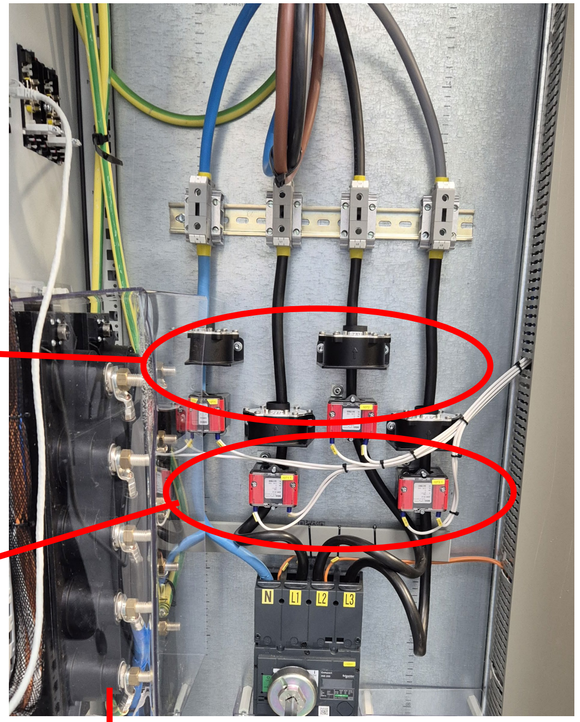
NAMING CONVENTIONS:

```
MPS_INT_PRL_X
  |   |  |  |   └ EQUIPMENT NODE NUMBER
  |   |  |  └ EQUIPMENT NODE:
  |   |  |     └ PBB= POWER BUSBAR
  |   |  |       PS1= POWER SOCKET 1PHASE
  |   |  |       PS3= POWER SOCKET 3PHASE
  |   |  |       PDC= POWER DISTRIBUTION CABINET
  |   |  |       VCC= VACUUM CONTROL CABINET
  |   |  └ LOCATION NAME:
  |   |     └ NET: NORTH END TOWER
  |   |       NBP: NORTH BEAM PIPE
  |   |       NSP: NORTH SPLITTER BEAM PIPE
  |   |       INT: INJECTION TOWER
  |   |       SSP: SOUTH SPLITTER BEAM PIPE
  |   |       SBP: SOUTH BEAM PIPE
  |   |       SET: SOUTH END PIPE
  |   |       TIM: TIMING SYSTEM
  |   |       OPT: OPTICAL TEST SETUP
  |   |       NAR: NOISY AREA
  |   └ (SUB-)SYSTEM NAME: (IF MULTIPLE SYSTEMS
  |                         ARE INDICATED)
  |   └ MPS: MAIN POWER SUPPLY
POWER GROUP IS GIVEN IN BETWEEN BRACKETS()
```

Power monitoring

- Three options for monitoring
  - Power quality meter
    - Display and/or ethernet
  - LEM IN400-S current transformers
    - Readout by suspension DAQ
    - Bandwidth: DC-0.8 MHz
  - LISN: Rode&Schwarz ENV4200
    - Requires power cycle
    - Bandwidth 150kHz-30MHz





Safety

Keep it save!

- Work safety
- Fire safety
- Equipment safety

Safety, opening a cabinet…

Safety rules for working inside cabinets which are connected to 230v and/or 400v.

- You are only allowed to open cabinets when you are certified!!
  - Occupational health and safety law (ARBO)
  - NEN 3140 certification mandatory
    - VOP under suspicion of VP certified person
    - VP certified person
- Who are certified and responsible at ET pathfinder:
  - See wiki
  - Peter and Eliott, VP certified

Contact list for main power works and operation

Name	E-Mail	Phone	Home institute	Task/Responsibility
Thijs	thijs.hoeben@maastrichtuniversity.nl		UM	Installation responsible
Dinesh	dinesh.doerga@maastrichtuniversity.nl		UM	Safety officer
Peter	p.cuijpers@maastrichtuniversity.nl		UM	NEN3140 VP certified person
Eliot	gauthier.duvieusart@maastrichtuniversity.nl		UM	NEN3140 VP certified person

Safety: emergency stops

Emergency stops

- All 230v/400v wall outlets and busbars in the cleanroom and noisy area are controlled by the general emergency stops
  - The emergency stop release procedures for each subsystem are on the wiki
  - A activated emergency stop can only be de-activated by reset button in the noisy area
- Some sub subsystems have their own emergency stop
  - E.g. Demaco LN2 cooling

Safety: emergency stops

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Power switching on/off and emergency stop/reset procedure [edit | edit source]

This section details the procedures and contact persons for each subsystem. To avoid damage, loss of work or other undesired states of equipment one needs to follow the gi
on or off.

Contact list sub systems (currently available sub-systems)

Sub system	Name	E-Mail	Phone	Home institute	Power off requirements:	power on requirements:	Documentation:
Siesmometers/Microphones				TBD	TBD		
Vacuum controls	Thomas, Thomas			KIT	Only after approval	TBD	
Timing	Bas			Nikhef	TBD	TBD	Timing sub system
Laser corner	Sebastian			UM	TBD	TBD	
Demaco cooling	Henk-Jan			UM	TBD(not powered)	TBD (not powered)	
Demcon crycooler	Henk-Jan & Demcon			Demcon			power requirements

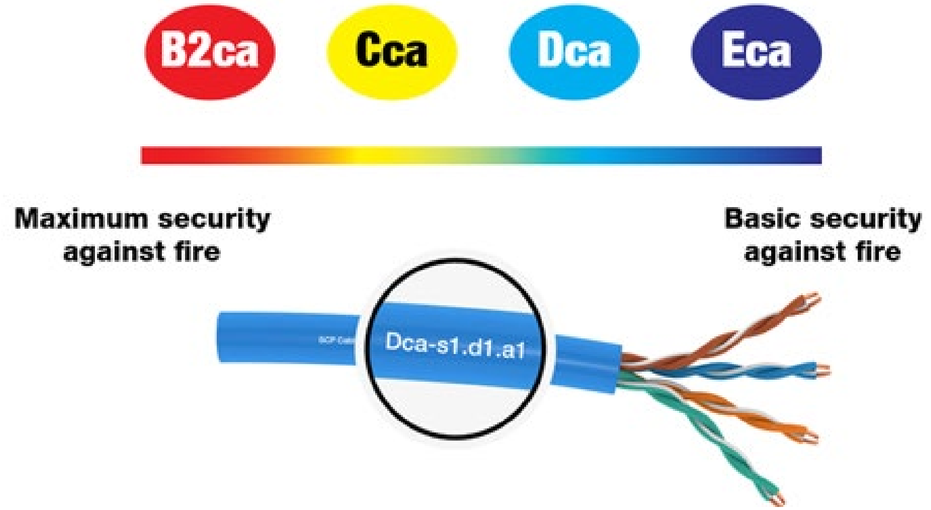
In case of any of the yellow or red emergency stops is activated all busbars, wall outlets or directly powered equipment will be cut from the main power directly. The procedure
emergency stop is given below.

1. In case of an emergency contact the BHV and Dinesh, and follow their instructions.
2. After the risk(s) or incident have been cleared, or in case of an accidental activation of the emergency button the power on requirements given in the table above must
3. After all pre-power on procedures have been executed, disarm the activated emergency button(s)
4. Activate the emergency stop reset, blue button, on the main power distribution cabinet in the noisy area.
5. Resume the power on requirements for each sub-system
6. Inform each sub-system responsible about the power cut, note time and date

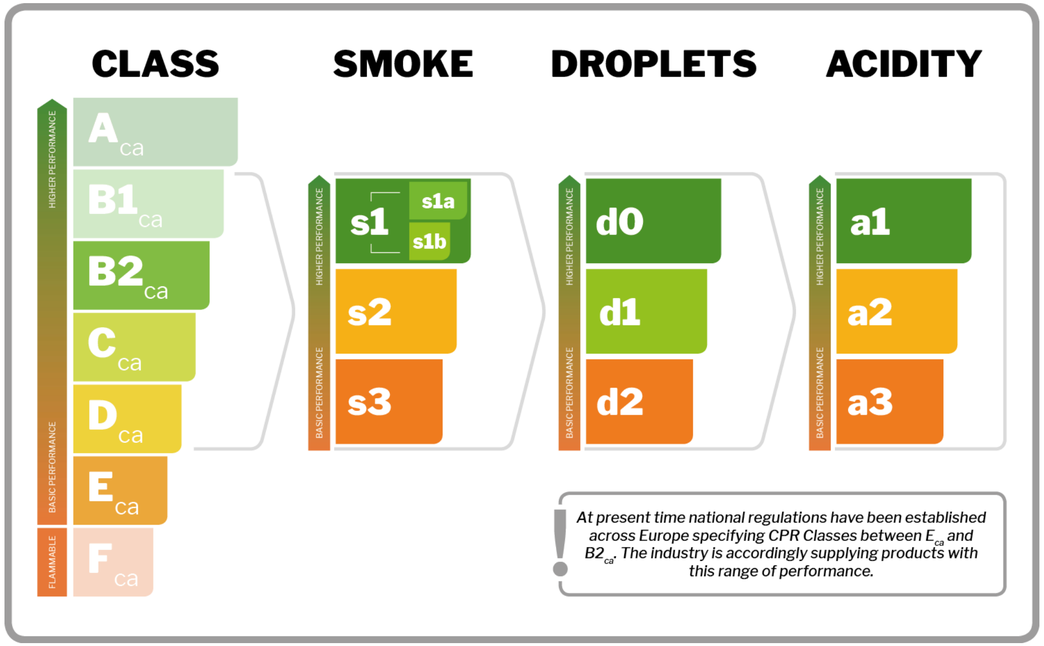
Cabling fire safety

Check specifications before you buy your cables!

- Current guideline: select Low Smoke Zero Halogen (LSZH) cable(s)
- Things change….
- EU standard: Construction Products Regulation (CPR) aka EN50575.
- a subset is included in the Dutch NEN8012-1/2:2023 standard. Last updates in 2023
- For new cabling a TBD class of “Eca/Dca/Cca/B2ca” cabling must be used in the cleanroom
- Cleanroom requirements are under discussion with the safety departments



CPR



NEN8012:2023

B2ca	Very High Fire Protection Self Extinguishing	Hospitals, Airports, and fire exits in public buildings (High density of people, people with limited mobility)
Cca	High Fire Protection Self Extinguishing	Public buildings, hotels, schools, & office buildings. (medium density of people)
Dca	Moderate Fire Protection Limited Emissions	Minimum Cable Requirements for general installations in some regions
Eca	Basic Fire Protection	Minimum Cable Requirements for general installation, residential (low density)

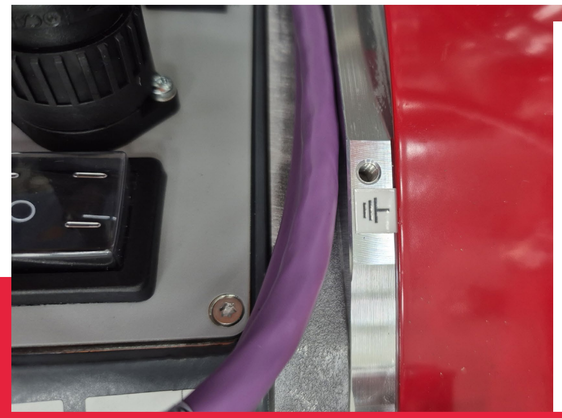
Grounding and equipotential bonding

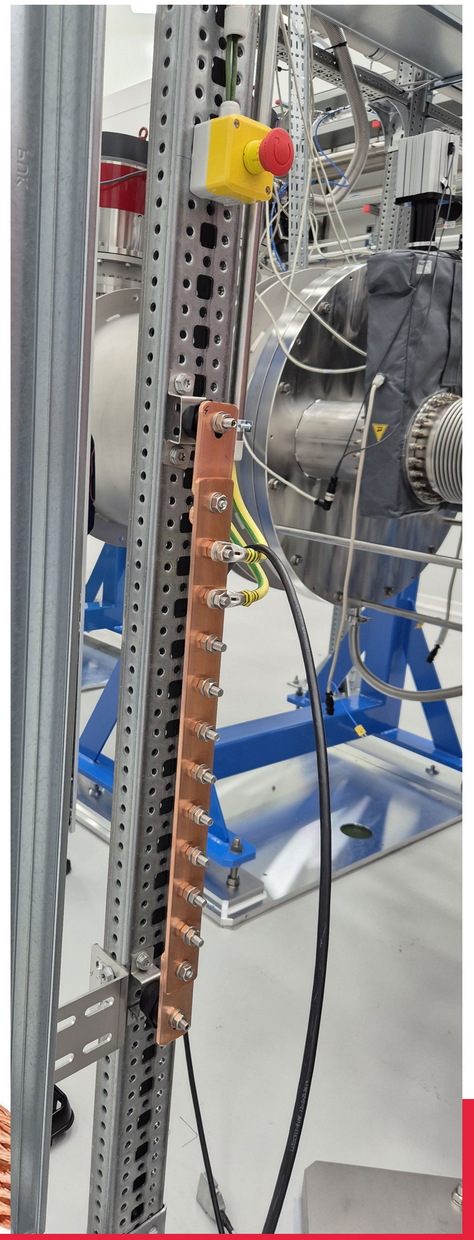
What has been done:

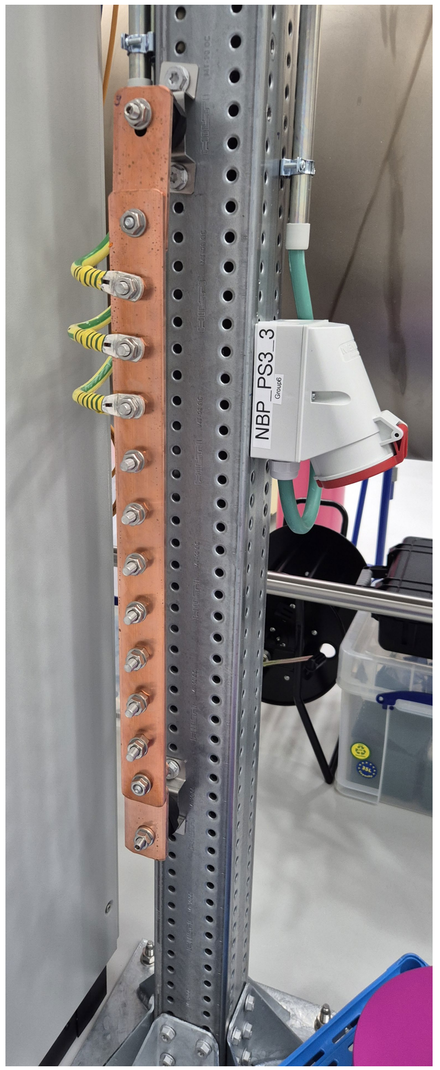
- Equipotential bonding bars installed at various locations
  - See floorplan slide
- See specifications of your equipment

What has not been done yet:

- Connect all the metallic structures and equipment to the grounding/equipotential bonding bars
- Use: as short as possible, low impedance thick copper bread or wire
  - Preferably >=35mm2 if possible







Cabling from A to B

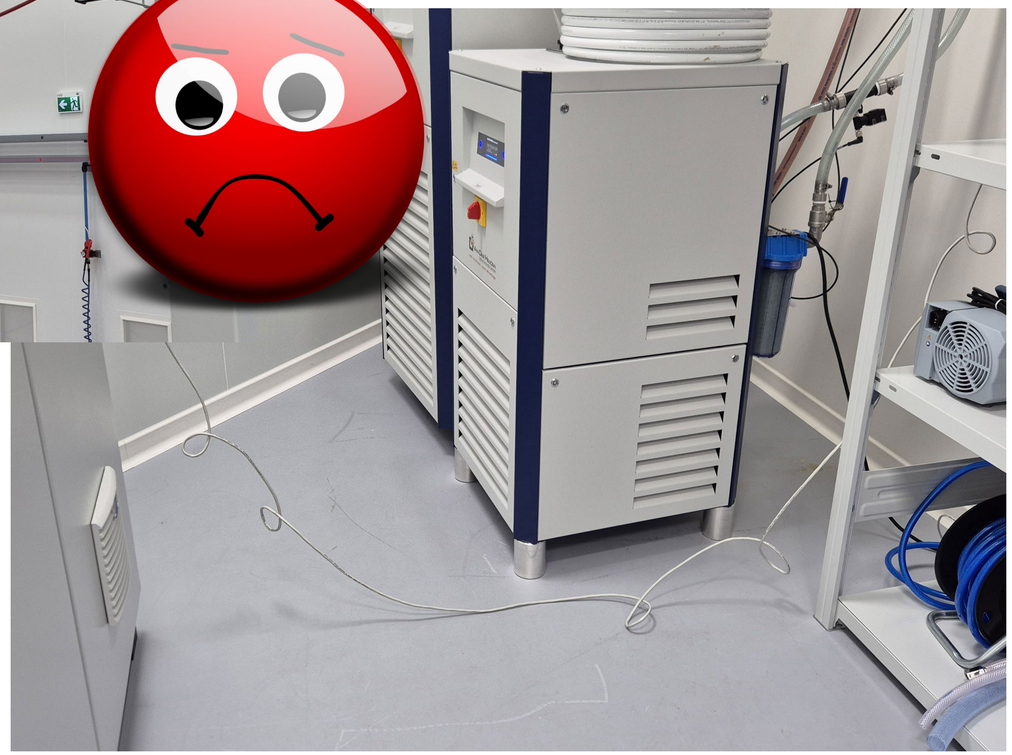
Cable ducts

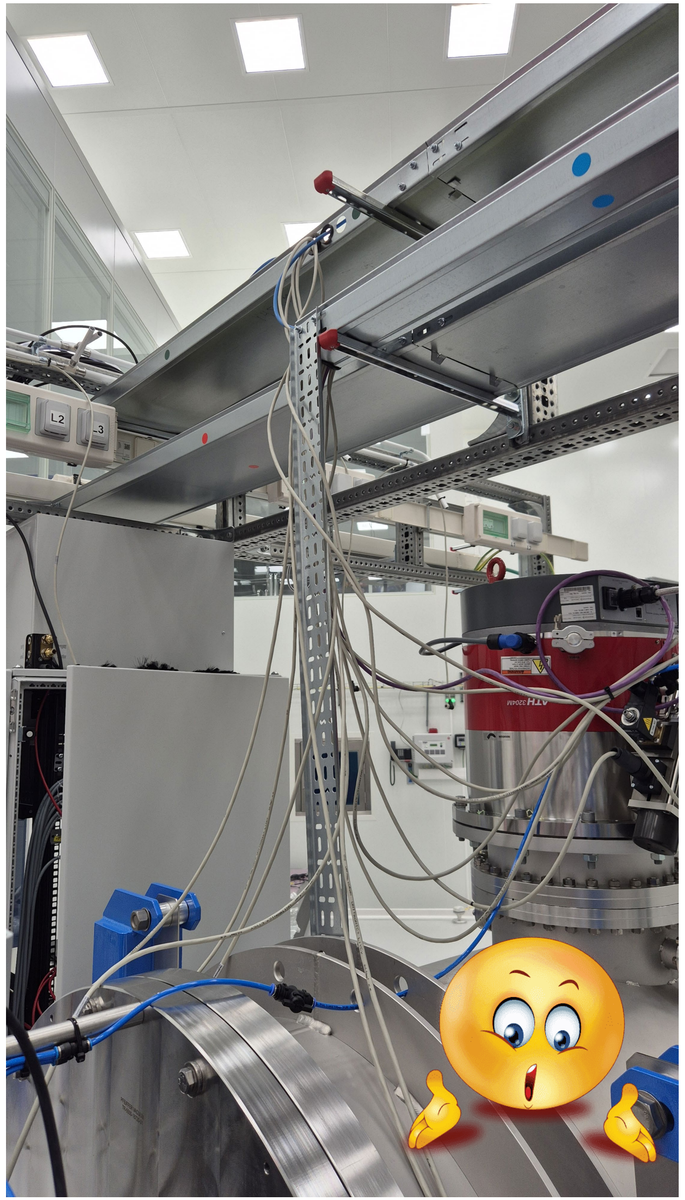
- Safe pathways
  - Strain relief and cable protection
- EMI shielding
- Separated by function
- Easy to clean

Cable ducts and cable routing

- Complete routing in the 3D mode
- Installation
- Three types of ducts
  - Power 230v&400v, red dots
  - Signal mainly vacuum system, blue dotted
  - Green dotted miscellaneous signals
    - Note: NEN1010: Mix of 230v/400v with signal/low power is **not** allowed
- Only cabling in ducts allowed!
  - Be professional! for safety, cleanliness, reliability and looks!
- Document your cables
- Use labels on both ends

Cable ducts and cable routing





Howto power your equipment?

- Specify your requirements e.g.
- Usage time
  - Temporary +/- < 4 weeks
  - Permanent +/- > 4 weeks
- Follow the specifications from the manufacturer, or designer
- Power usage
  - E.g. <3,6 kW (standard 16A circuit breakers)
  - 230v or 400v
- Safety
  - Sub-system emergency stop required?

Howto power your equipment?

- Baseline: Use the Schneider Canalis KN busbars
- Installed at various locations(see floorplan)
  - EMI clean or dirty
- Assemble a tap-off unit according your requirements
  - Determine circuit breaker value
  - Determine short circuit current(read datasheets)
  - Select your type of socket, with the right current rating.
  - Use an earth leakage switch
- Ask a certified person to install the tap off unit(s)
- Document on wiki:
  - On/off procedure if applicable
  - Note your name as responsible/contact for the sub-system
  - Power usage specifications

Connecting your device, e.g. a turbopump

E.g. connecting an ATH 3240 magnetically levitated turbopump

- Circuit breaker requirements:
  - Curve D
  - Icc >= 10kA
  - Earth leakage switch
  - Cable <=7 meter
- Earth
  - Separate earth connection required
  - Braid or green/yellow
  - >= 3mm2
  - Impedance <0.1 Ohm at 25A

Pfeiffer Datasheet:

5.7.1 Customer electrical installation protection

Installation protection with circuit breaker

The user must supply the pump from facilities equipped with main circuit breaker, curve D (IEC 60947-2), in accordance with local regulations and with at least a 10 kA short circuit cut-off capacity. This protection device should be in close proximity to the pump (no further than 7 m) within line of sight of the pump.

Main circuit breaker rating: *(see 15.3.4)*.

Differential circuit breaker

In the event of an insulation defect, you must install a differential circuit breaker on the main power supply to protect personnel *(see 15.3.4)*. Contact your service center for advice. In all cases, comply with current local regulations.

The pump is Class 1 equipment and therefore must be earthed. The user must check that the electrical installation to which the product is connected has an earth wire that complies with standards and is properly connected to earth.

An IEC 60417#5017 ⏚ symbol is located on the pump body *(see 4.2)*.

CAUTION

Functional earthing and Electric shock hazard

The installer must provide **a separate earth (ground) conductor** to earth pump. Use an un-insulated braid or a separate insulated green/yellow conductor with a minimum 9AWG (3mm2) conductor. The impedance between the pump-body and the earth connection point must be < 0.1 Ohm at 25A.

➔ Use an M4 x 8 screw and a lock washer fitted to the earth hole from the pump to secure the earth conductor to the pump.

WARNING

Absence of emergency off

This pump is not equipped with an emergency off device EMO or a lock-out device. It is designed to be integrated with the host tool equipment equipped with an emergency device. This EMO device must de-energize the pump when it is activated.

Thanks!

Work safe