Report on 1st Grounding Implementation Workshop (Lund, 29th August 2018)

IKON 15

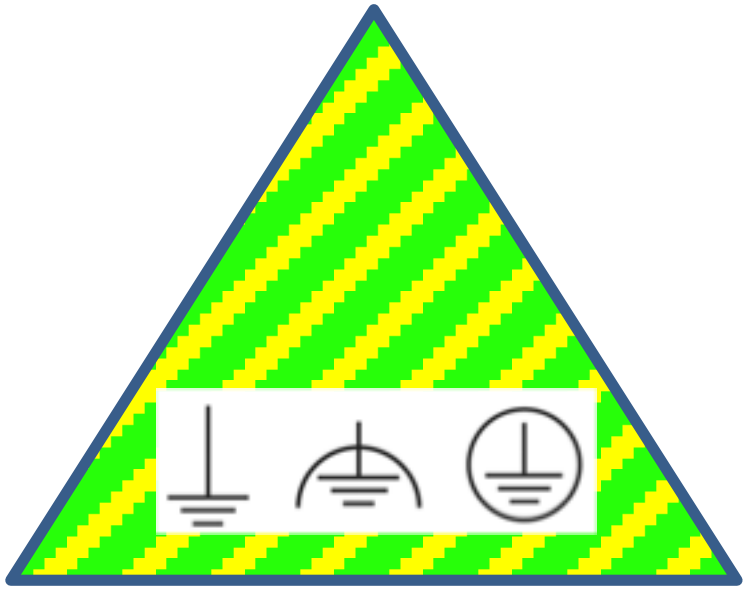
Lund, 13th September 2018

Thomas Gahl

- Group Leader Motion Control & Automation -

Grounding Triangle (functional)

Isolation



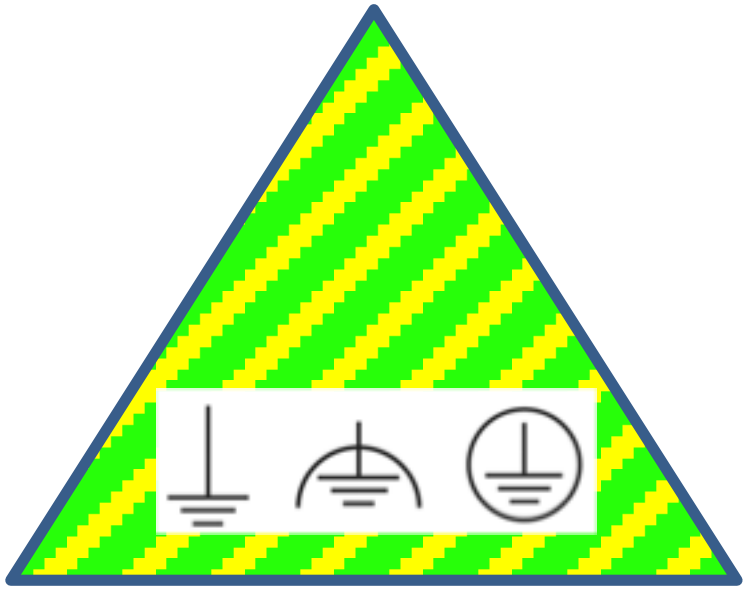
Electrical Power

Test & Measurement

Grounding Triangle (functional)

Isolation

Electrical Safety, Marking, Procedures



Electrical Power

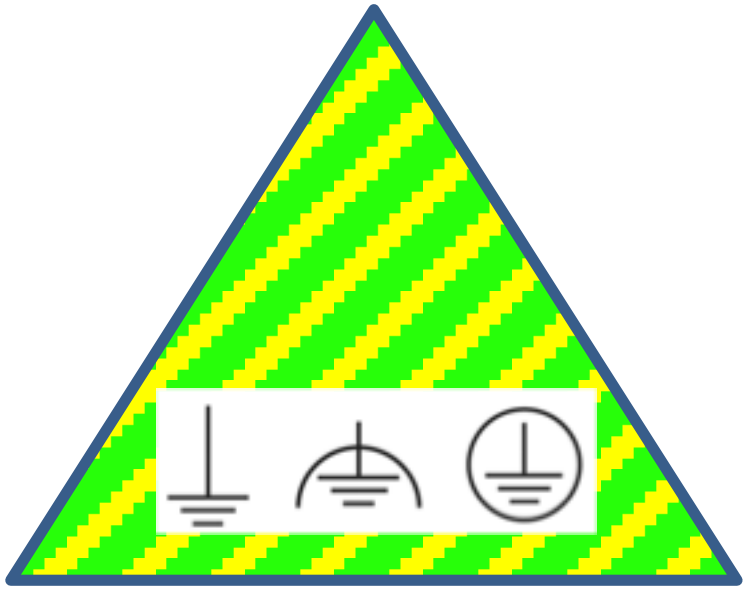
Test & Measurement

The three main pillars of grounding

- Clean electrical power infrastructure
  - No connections between equipment powered from different sub-stations
  - Only one connection N-PE (at the substation)
  - 5 wire cabling for instruments supply (TN-S system)
  - Limited and easy to control connections between PE and PB (bonding network)
- Isolation of installations (“zoning concept”)
  - (more details in the next slides)
- Test & Measurement for verification
  - Permanent mains analysis for each instrument
  - Control of grounding currents
  - Warning if values are changing
  - Logging of events to be related to electrical problems

Scope of first Workshop

Zoning
(this workshop)



Electrical Safety, Marking, Procedures
(next workshop)

Electrical Power
(next workshop)

Test & Measurement
(next workshop)

Agenda and Participants

- Participants present in Lund or via Vidyo from: NMX, BEER, C-SPEC, Bifrost, Miracles, Heimdal, Loki, Freia, Vespa, Estia
- Absent: Magic, T-Rex, Skadi, Odin, Dream

Grounding Implementation Workshop

Wednesday 29 Aug 2018, 08:30 → 17:45 Europe/Stockholm

Conference room Tellus (ESS HQ)

08:30 → 08:45 **Arrival, Agenda, Intro** — Conference room Tellus

Convener: Gabor Laszlo (European Spallation Source ERIC)

08:45 → 09:45 **Grounding principles, CF infrastructure + alternatives, (What, Why)** — Conference room Tellus

Convener: Mr. Thomas Gahl (European Spallation Source ERIC)

slides

09:45 → 10:15 **Parallel Session: Discussion on Grounding Zones Map: Group 1** — Conference room Tellus

Convener: Mr. Thomas Gahl (European Spallation Source ERIC)

slides

Agenda and Participants

EUROPEAN SPALLATION SOURCE

10:30 → 12:00 **Implementation - Cave (How)** — Conference room Tellus

Convener: Mr. Thomas Gahl (European Spallation Source ERIC)

slides

12:00 → 13:00 **Lunch** — 1h — Conference room Tellus

13:00 → 13:45 **Implementation - Bunker** — Conference room Tellus

Convener: Mr. Thomas Gahl (European Spallation Source ERIC)

slides

13:45 → 14:30 **Implementation - Beamline** — Conference room Tellus

Convener: Mr. Thomas Gahl (European Spallation Source ERIC)

slides

15:45 → 16:45 **Parallel Session: Agreement on Grounding Zones Map: Group 2** — Conference room Pegasus

Convener: Richard Hall-Wilton (European Spallation Source ERIC)

slides

16:45 → 17:00 **Wrap-up** — Conference room Tellus

Convener: Gabor Laszlo (European Spallation Source ERIC)

Why zoning?

Why zoning?

Why zoning?

Why zoning?

Why zoning?

- You don’t disconnect you from the world, but control your entrance and guide all currents around.

Basis

ESS-00147271

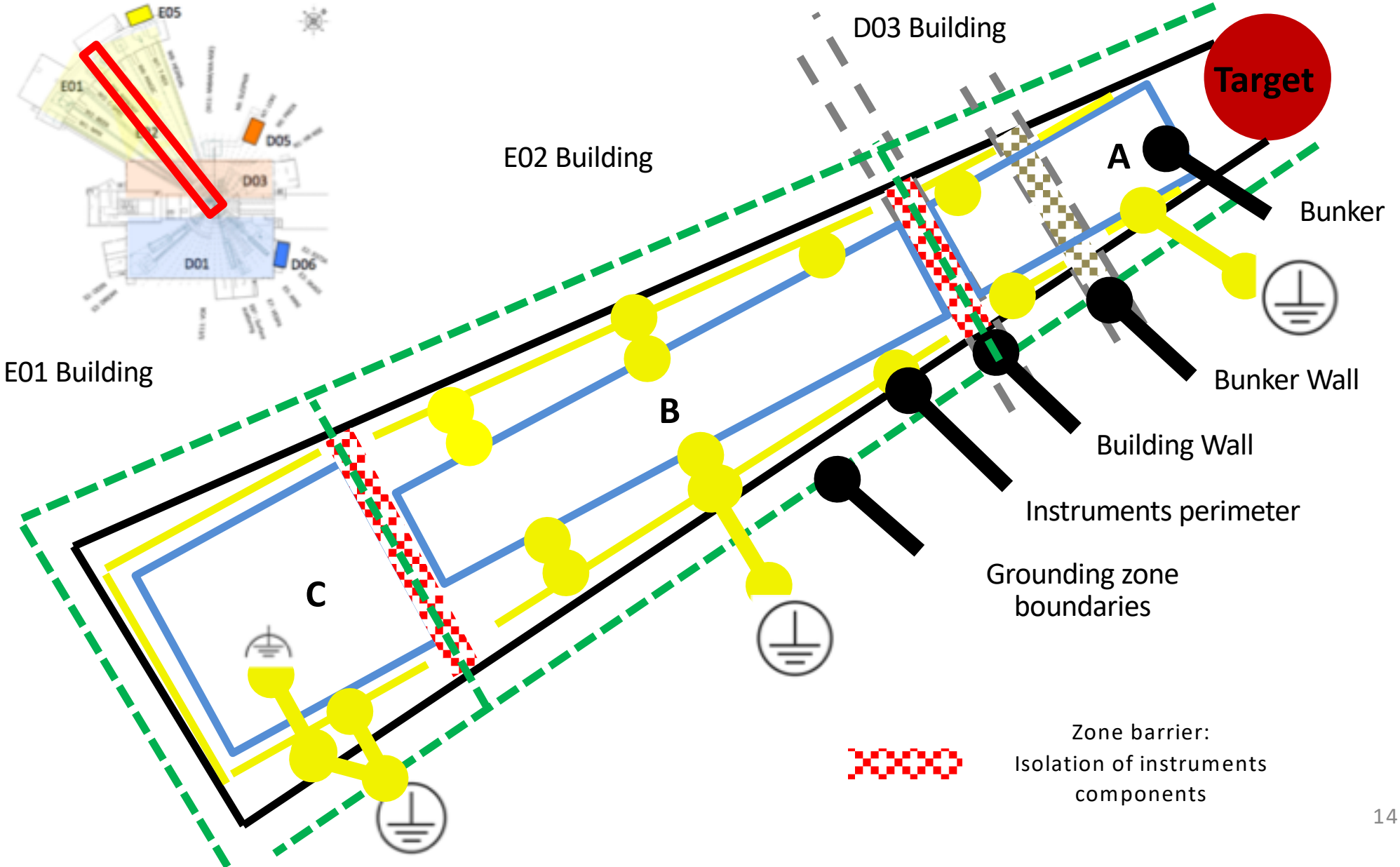
“Guidelines for Instrument Power and Grounding”

Published as v1 in CHESS next week.

ESS GUIDELINES FOR INSTRUMENT POWER AND GROUNDING

	Name	Role/Title
Owner	Scott Kolya	ESS, Deputy Detector Group Leader
Reviewer	Thomas Gahl	ESS, Group Leader Motion Control & Automation Motion Control & Automation
	Richard Hall-Wilton	ESS, Detector Group Leader
	Oliver Kirstin	ESS, Head of Instrument Technologies Division
Approver	Shane Kennedy	ESS, Interim Deputy Science Director and Project Leader

Long Instruments

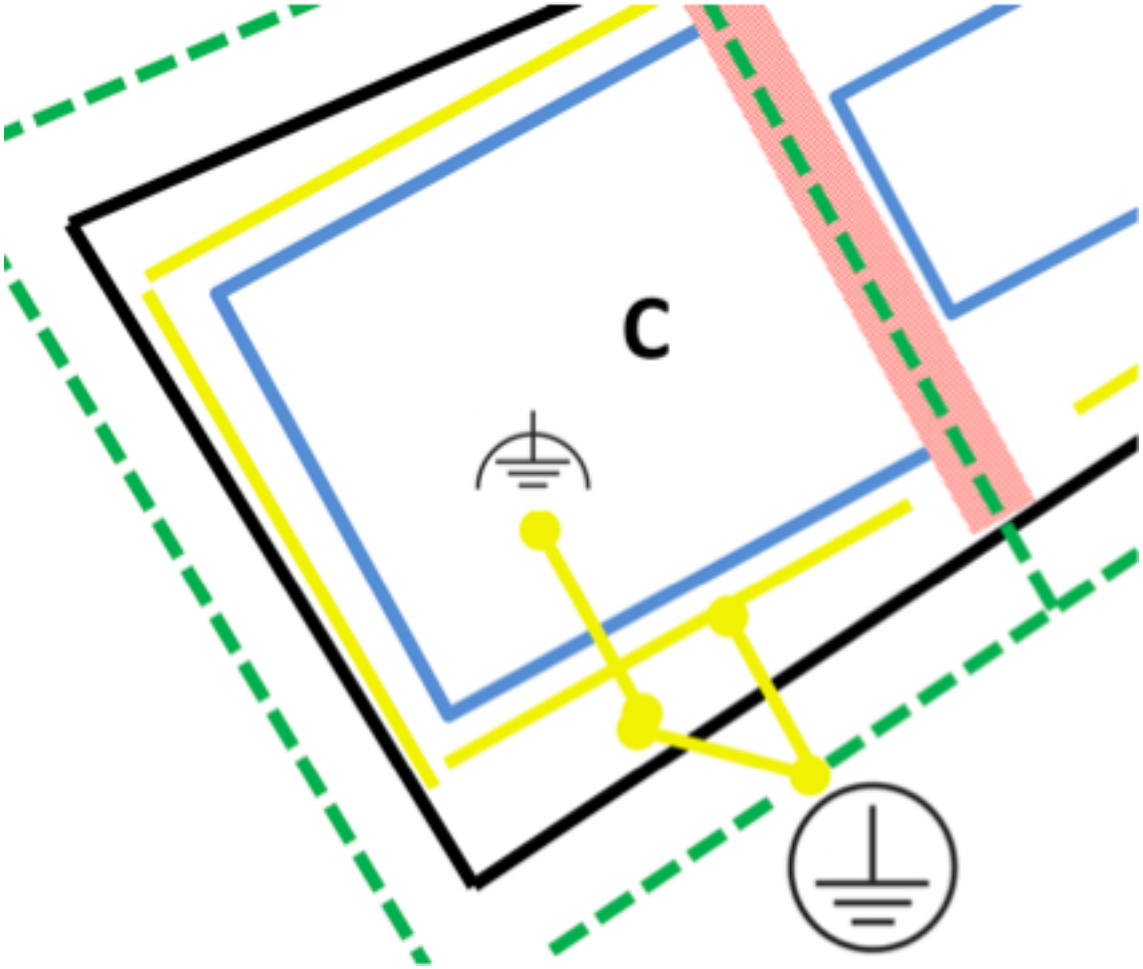


L1 - High level requirements

1. The grounding installations shall be divided into three greater grounding zones, following the different power supply zones in the D- and E-buildings.
2. The grounding of NSS instruments shall be implemented in a way that interferences from in- and outside the instrument through air, power cables or grounding bonds shall not compromise the availability, functionality and performance of the single instrument (e.g. by introducing isolated instruments grounding zones).
3. The number of grounding zones shall be minimized.
4. Lessons learned from other facilities shall be included in the design of the grounding installations.
5. Grounding shall fulfill functional, EMC and safety requirements to ESS and European standards.

Implementation I - Grounding connections

- Equipotential bonding bar (EBB) for standard safety and functional grounding
- “Clean Earth” connections for sensitive equipment connecting directly to the ground reference point of the zone.
- The reference grounding point will be connected to the central grounding point in the substation, routed together with the power supply cable.



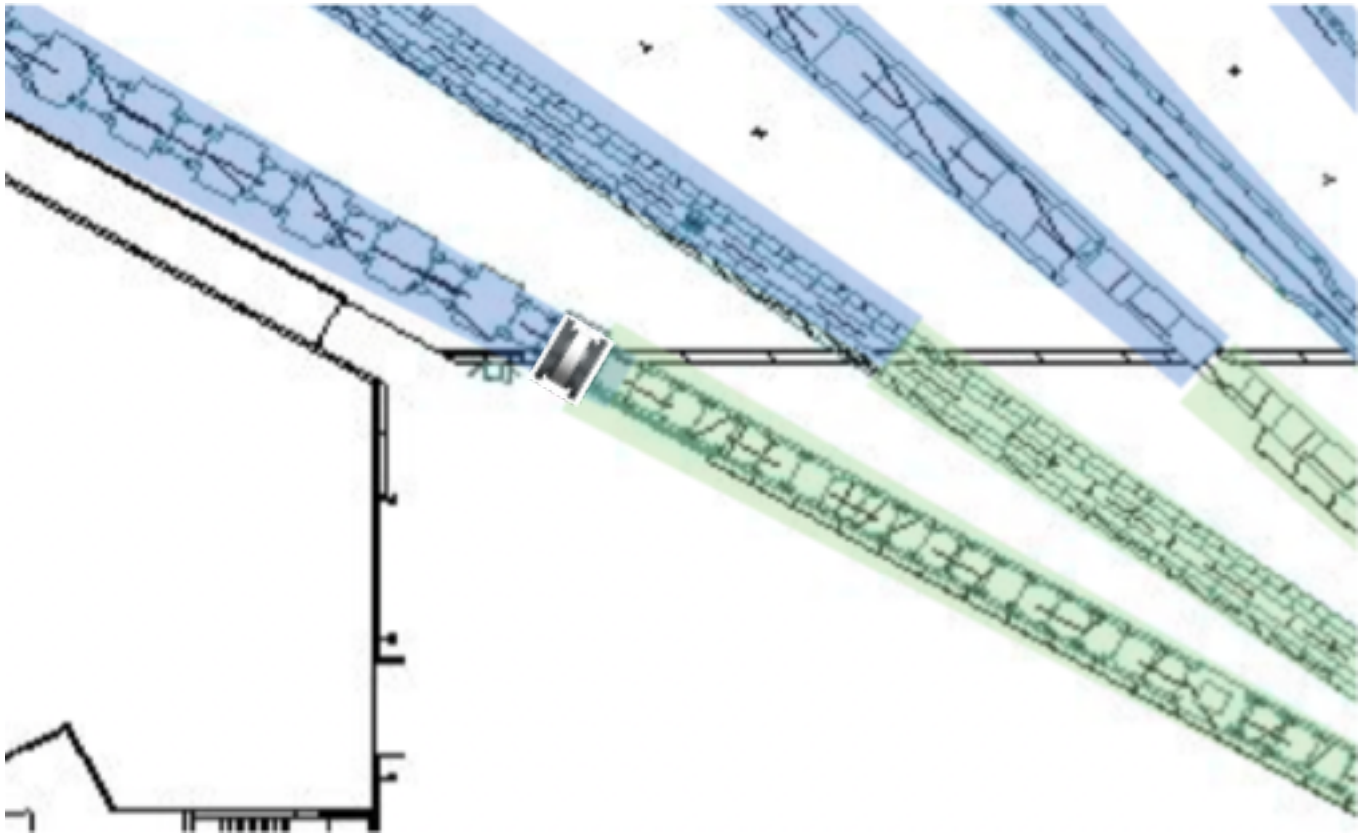
Implementation II – What is isolation ?

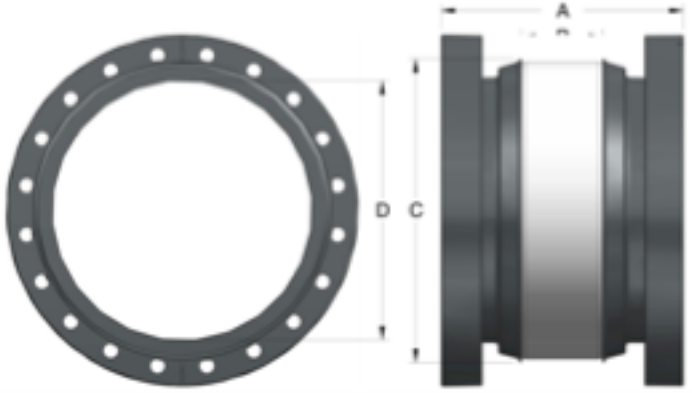
- Low impedance vs. high impedance
- Avoid metal-to–metal connections
- Water is good as isolator
- Tubes need to be isolated (cooling, vacuum, gases)

- One entrance in the zone (ref ground point)
- Breaking the zone is possible when experiment is off
- Breaking the zone is possible for short time
- Temporary installation (Scaffolding etc.): Handled by Procedure

- Grounding currents will be monitored and time stamped
- PSS discussion was postponed

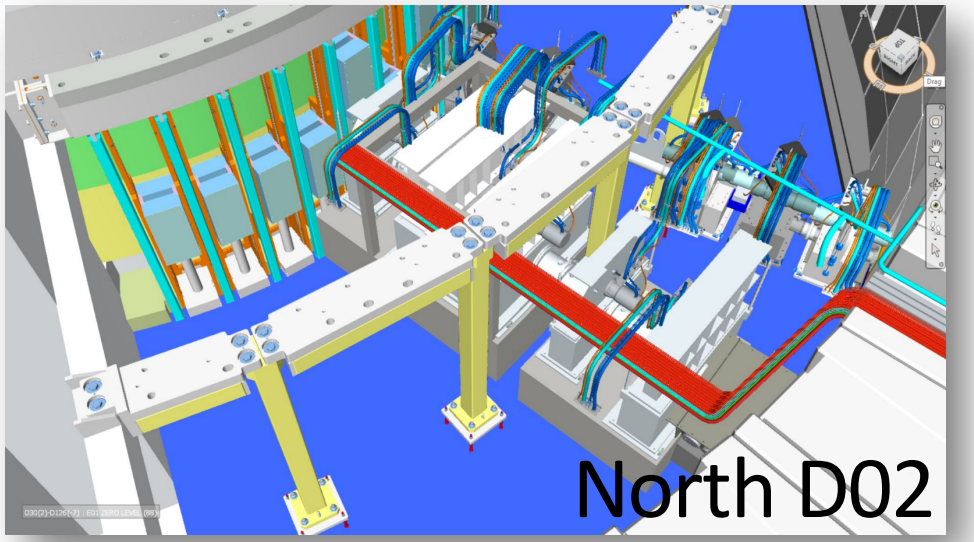
Implementation III -- Isolation Neutron guide

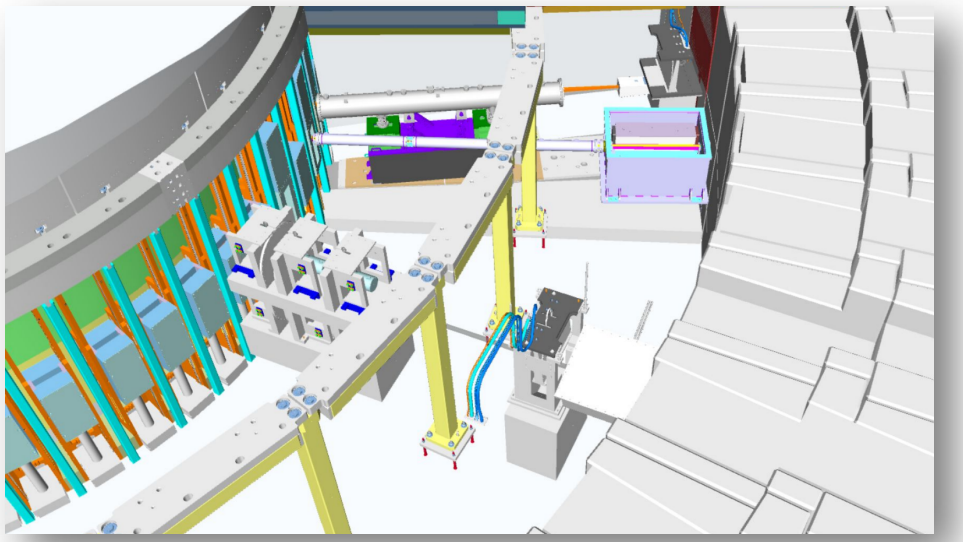


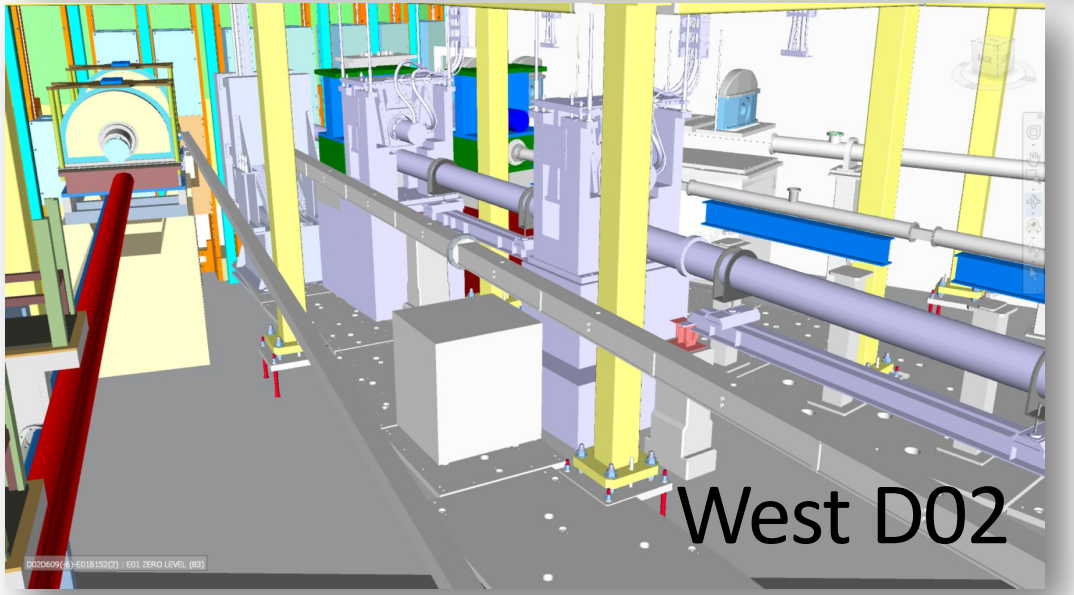


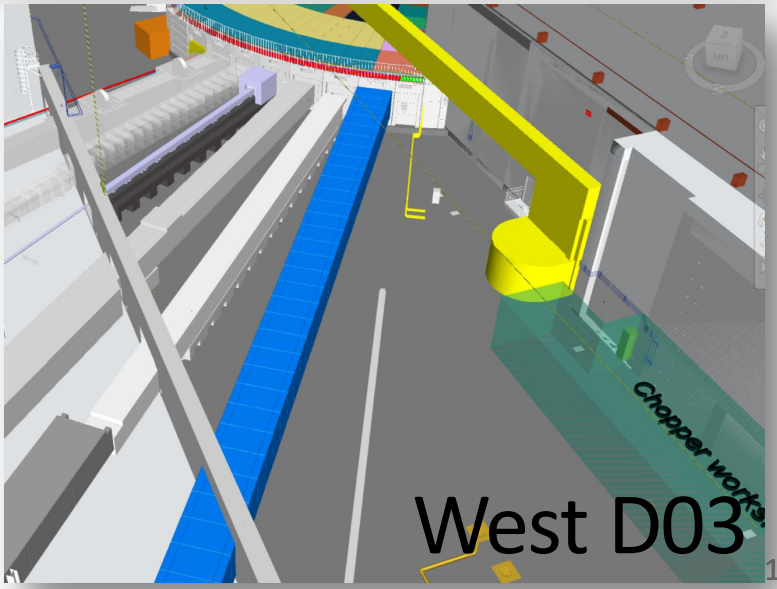
Metal-ceramic-metal
Lesker DN160
~2000 EUR

Implementation IV - Bunker



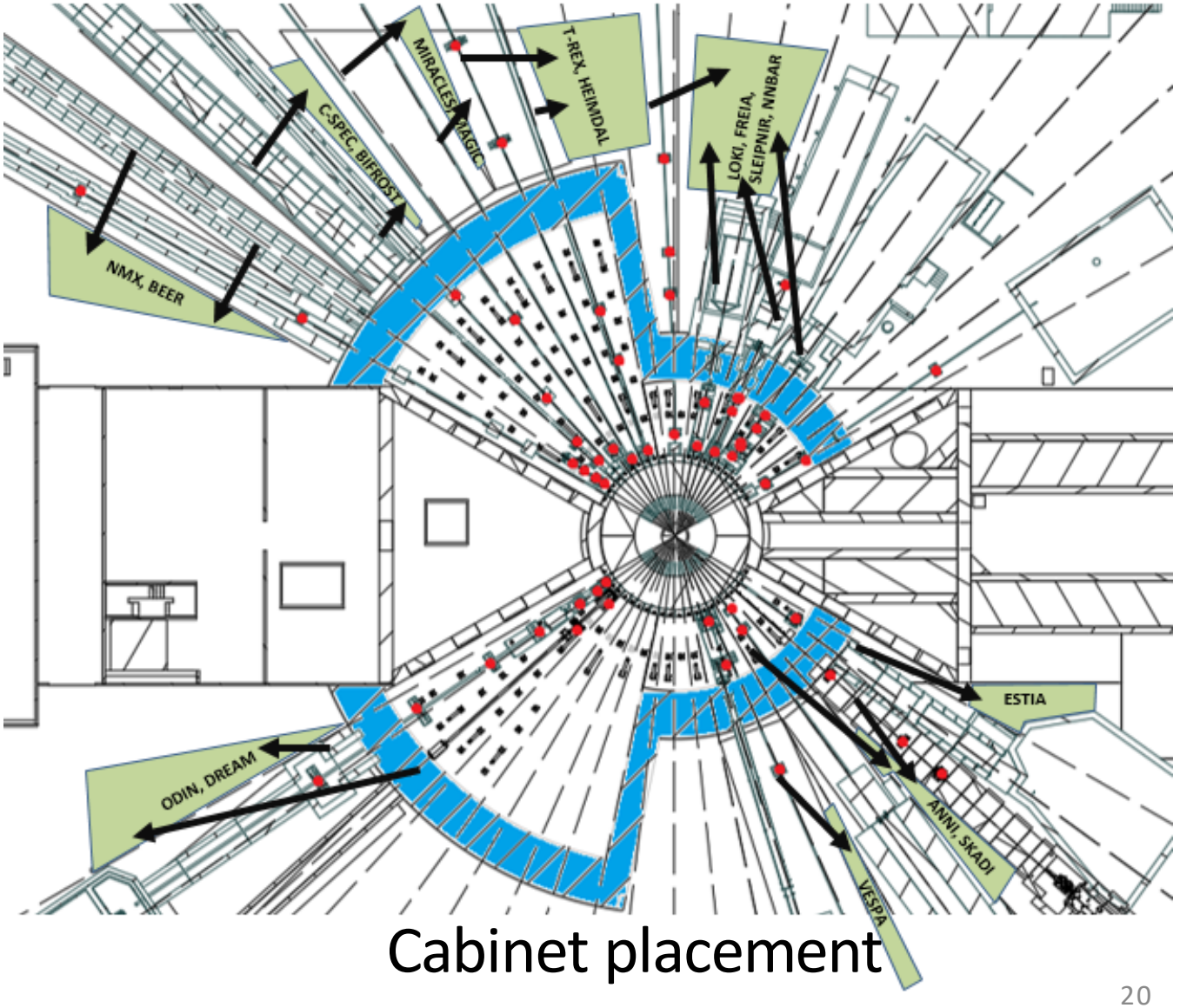






Implementation IV - Bunker

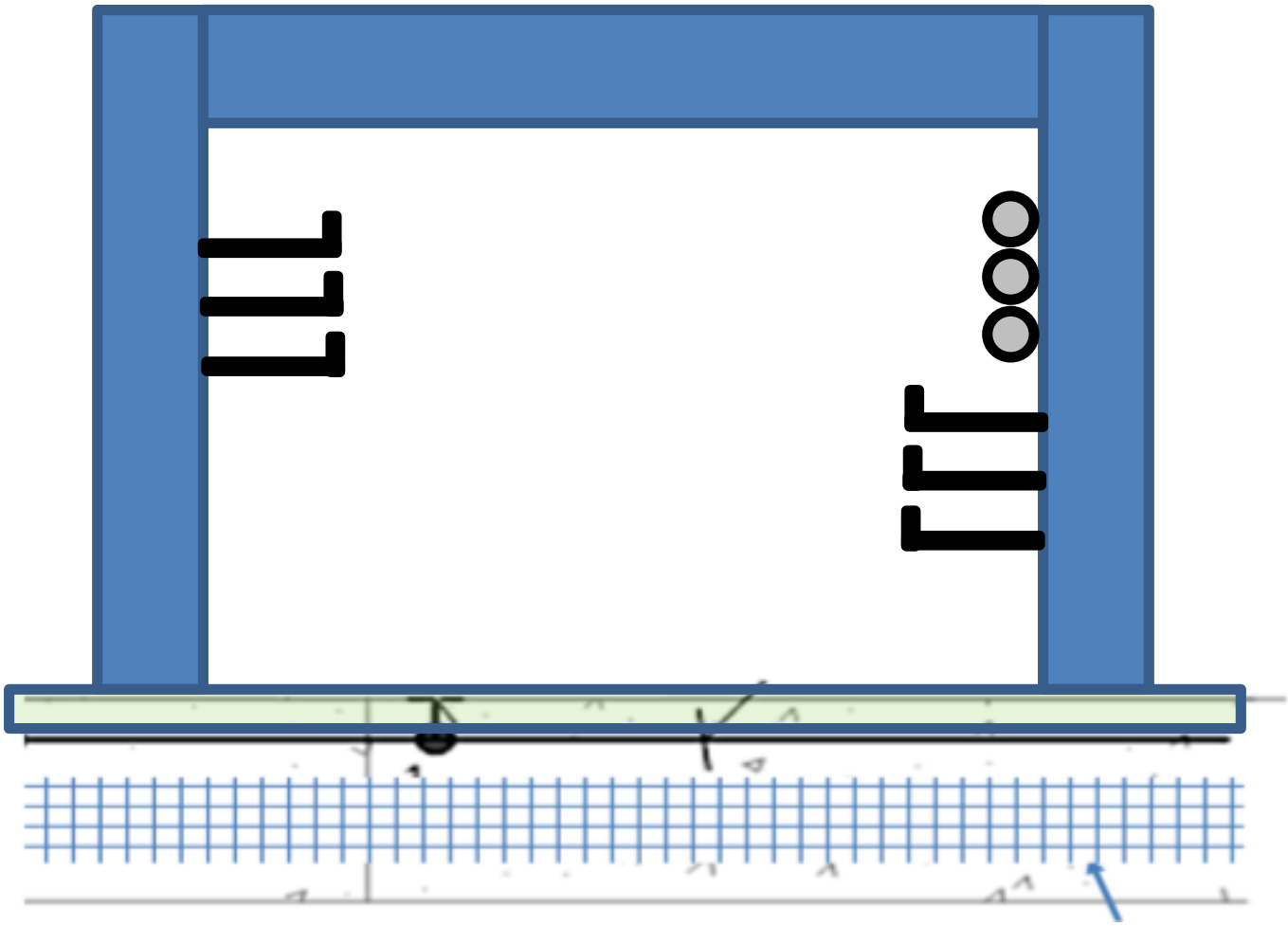
- Bunker zone + adjacent beamlines parts are one zone
- No isolation between baseplates and floor reinforcement necessary
- Still work with reference ground point, but point is connected to local ground
- Beam monitors need to be isolated



Cabinet placement

Implementation V - Cave

- Concrete of floor is good enough as isolation
- Cave wall belong to the zone
- All installations on the wall don't need to be isolated
- Fire alarm circuits need to be isolated
- Instruments Cranes belong to the zone
- Hall cranes are typically used outside experiment



Implementation VI – Fixing to floor

- Chemical anchors with plastic distance rings

Foil pack: HIT-RE 500 V3

(available in 330, 500 and 1400 ml cartridges)

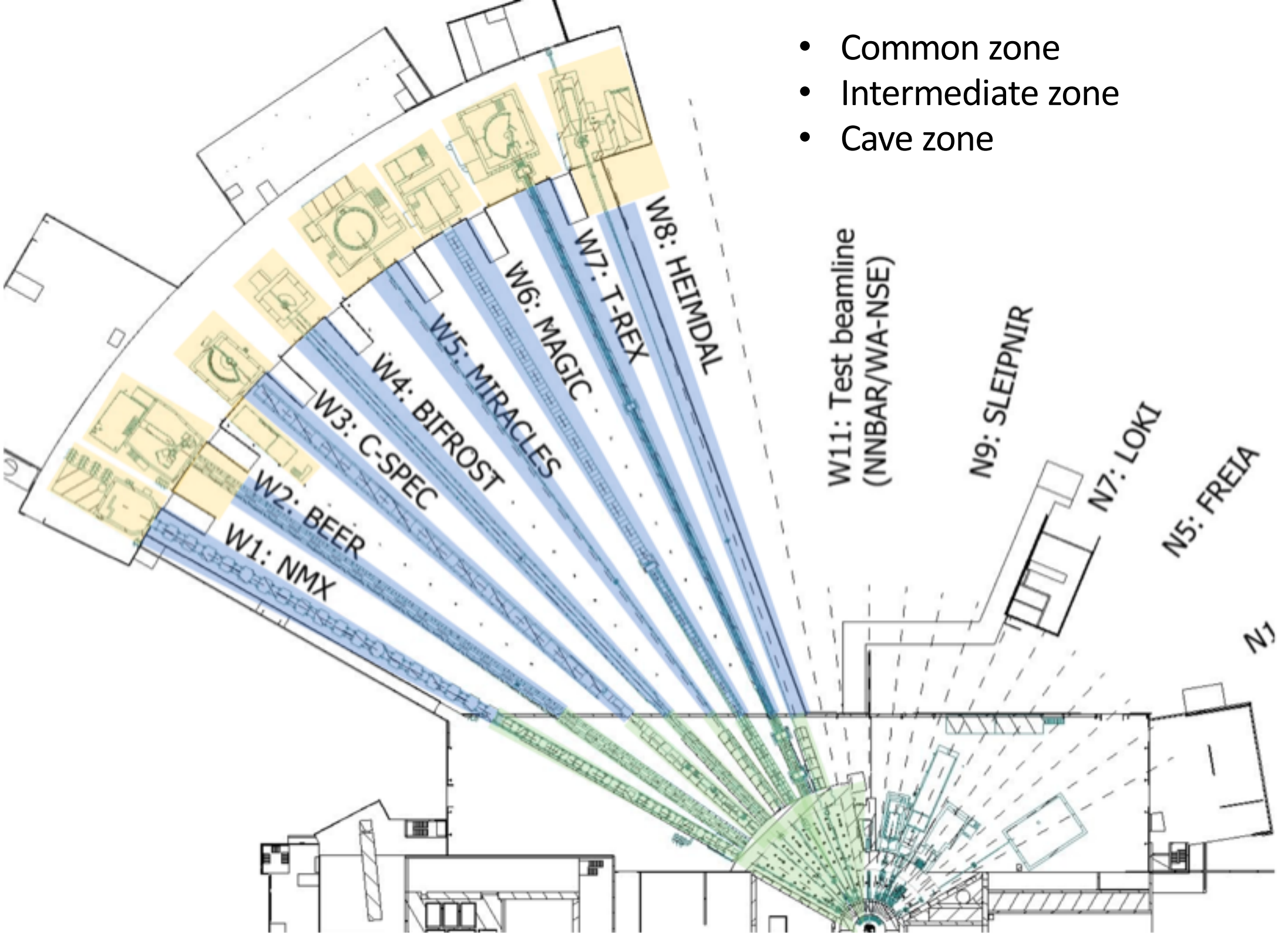
Anchor rod:
HIT-V
HIT-V-F
HIT-V-R
HIT-V-HCR
AM 8.8 (HDG)
(M8-M39)

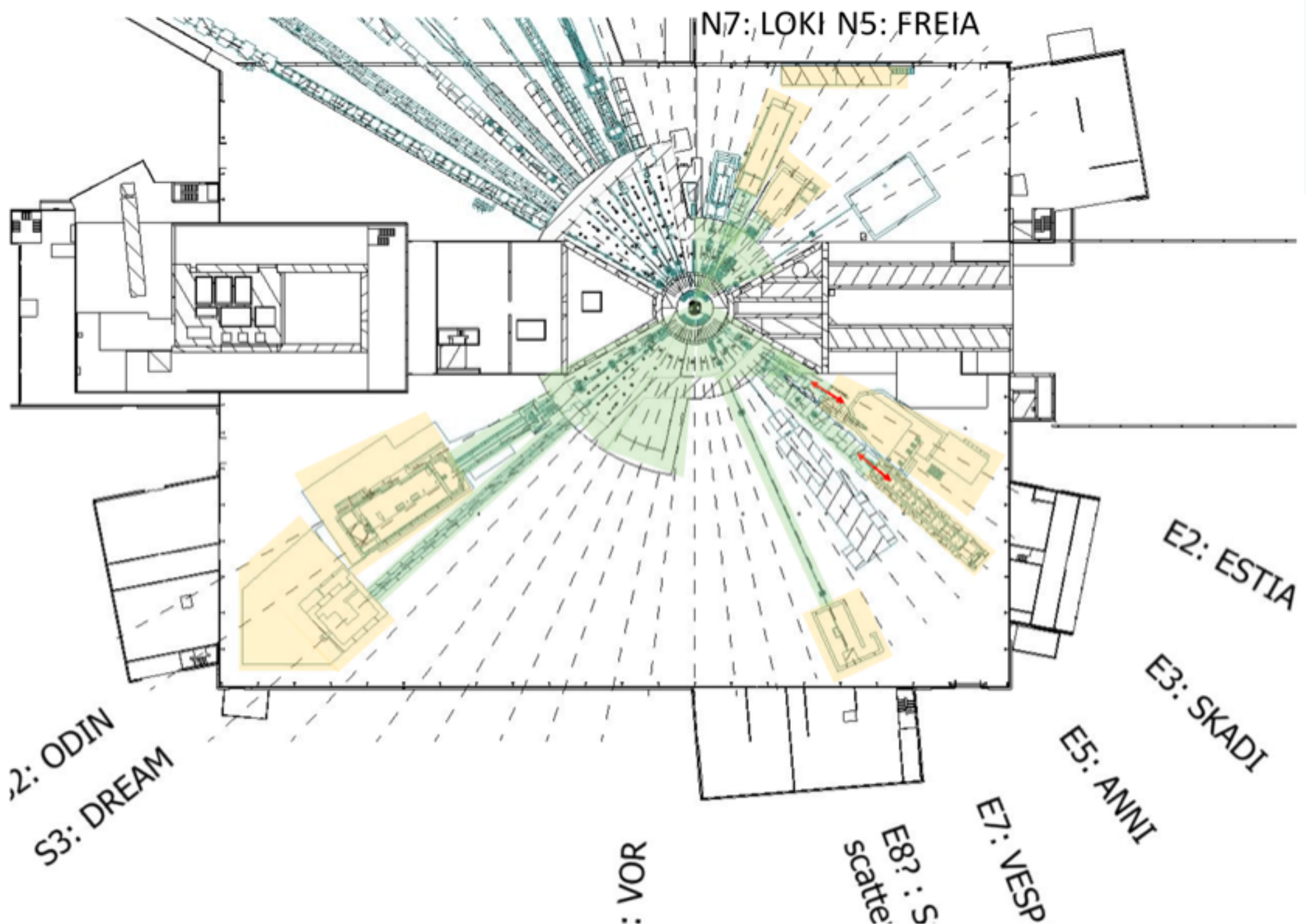
Implementation VI – Marking, Naming

- Connections and isolations need to be marked clearly:
  - Border lines on the floor, in the shielding walls etc.
  - Isolation elements (color, human readable text on the isolation parts)
  - Reference grounding points
  - Standard equipotential bonding points
  - Clean earth bonding points

- Names of the max. three zones:
  1. Common zone (bunker zone)
  2. Intermediate zone
  3. Cave zone

- Common zone
- Intermediate zone
- Cave zone




N7: LOKI N5: FREIA
E2: ESTIA
E3: SKADI
E5: ANNI
E7: VESP
E8? : S
scatte
VOR
S3: DREAM
2: ODIN

Next steps

- Publish ESS-00147271 (Guidelines) Sept.
- Finalise Minutes of Workshop Sept.
- Organise second Workshop – electrical, safety Dec.
- Publish Implementation Rules End 2018

Thanks!

The grounding symbols (IEC 60417)

https://incompliancemag.com/article/the-grounding-symbols/

Identifying the ground terminal is critical to ensuring the products you design can be properly used and serviced in a safe manner. The actual symbols used to indicate ground terminals are found in IEC 60417 *Graphical symbols for use on equipment* (Figure 1).

Figure 1: IEC 60417 ground symbols

Here are the precise IEC definitions for each symbol:

No. 5017 Earth (ground): To identify an earth (ground) terminal in cases where neither the symbol 5018 nor 5019 is explicitly stated.

No. 5018 Noiseless (clean) earth (ground): To identify a noiseless (clean) earth (ground) terminal, e.g. of a specially designed earthing (grounding) system to avoid causing malfunction of the equipment.

No. 5019 Protective earth (ground): To identify any terminal which is intended for connection to an external conductor for protection against electrical shock in case of a fault, or the terminal of a protective earth (ground) electrode.

No. 5020 Frame or chassis: To identify a frame or chassis terminal.