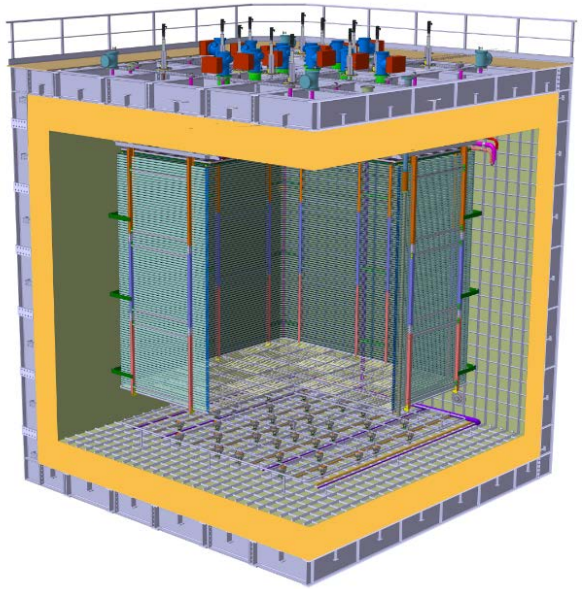
ProtoDUNE-DP integration organisation and plans

D. Duchesneau / S. Murphy

- Integration group organisation and activities
- Infrastructure areas, nomenclature and naming conventions
- Status of detector construction and schedule
- Document sharing organisation



Integration 16/06/2017

Integration group organisation and activities

The construction, installation, cabling, etc.. of the ProtoDUNE-DP detector are covered and supervised by the Integration Working Group (IG):

The activities include:

- The definition of the infrastructure areas. (e.g cryostat-roof, cryostat-inside, CR-185, CRB-EHN1, rack platform)
- The definition of the work, HR requirements, material, safety issues related to each of those areas
- The organisation the sequencing of the various activities
- The review and update of the planning for the detector preparation and construction

Identify and follow the steps established for each element entering in the detector construction:

- Final design => based on various inputs (cf: Technical Board) + experience from 3x1x1 in some cases
- Validation of the design by safety
- Procurement
- Preparation of the sites for assembly (CR185, CRB….)
- Pre-assembly, tests QA/AC, prepare safety installation document (PPSPS + Impact)
- Installation in EHN1 (in cryostat or on platforms)
- Additional tests

Organisational matters:

- Have bi-weekly meetings on Friday 2pm CET
  => specific mailing list CENF-WA105-INTEGRATION@cern.ch

⇒ During those meetings groups involved for the different parts will present status and update their contributions

- We also have regular technical integration meetings with CERN NP

- Reminder: Light Readout Meetings every 2 weeks organised bys Inés: the mailing list is CENF-WA105-LIGHT-READOUT@cern.ch

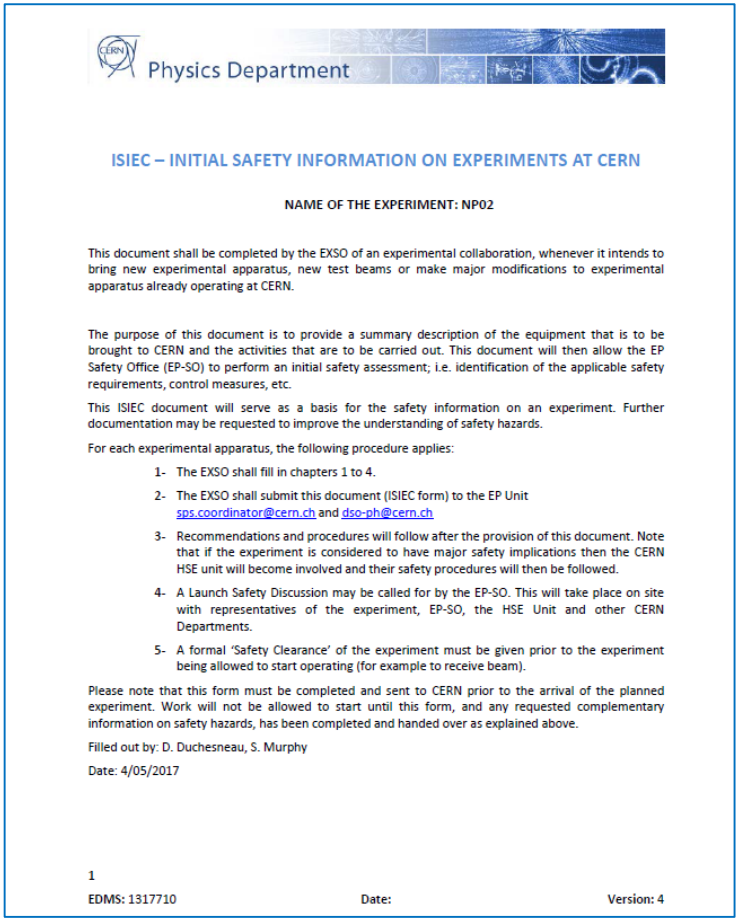
Additional group list can be created to cover any specific integration item

A word about Safety and CERN

Continuous communication with HSE (CERN safety dept),

- 1st contribution: the ISIEC document (Initial Safety Information on Experiments at CERN) submitted on 7/05/2017

- Now, started to write required documents describing the design and FEA calculations.



Physics Department

ISIEC – INITIAL SAFETY INFORMATION ON EXPERIMENTS AT CERN

NAME OF THE EXPERIMENT: NP02

This document shall be completed by the EXSO of an experimental collaboration, whenever it intends to bring new experimental apparatus, new test beams or make major modifications to experimental apparatus already operating at CERN.

The purpose of this document is to provide a summary description of the equipment that is to be brought to CERN and the activities that are to be carried out. This document will then allow the EP Safety Office (EP-SO) to perform an initial safety assessment; i.e. identification of the applicable safety requirements, control measures, etc.

This ISIEC document will serve as a basis for the safety information on an experiment. Further documentation may be requested to improve the understanding of safety hazards.

For each experimental apparatus, the following procedure applies:

1- The EXSO shall fill in chapters 1 to 4.

2- The EXSO shall submit this document (ISIEC form) to the EP Unit sps.coordinator@cern.ch and dso-ph@cern.ch

3- Recommendations and procedures will follow after the provision of this document. Note that if the experiment is considered to have major safety implications then the CERN HSE unit will become involved and their safety procedures will then be followed.

4- A Launch Safety Discussion may be called for by the EP-SO. This will take place on site with representatives of the experiment, EP-SO, the HSE Unit and other CERN Departments.

5- A formal 'Safety Clearance' of the experiment must be given prior to the experiment being allowed to start operating (for example to receive beam).

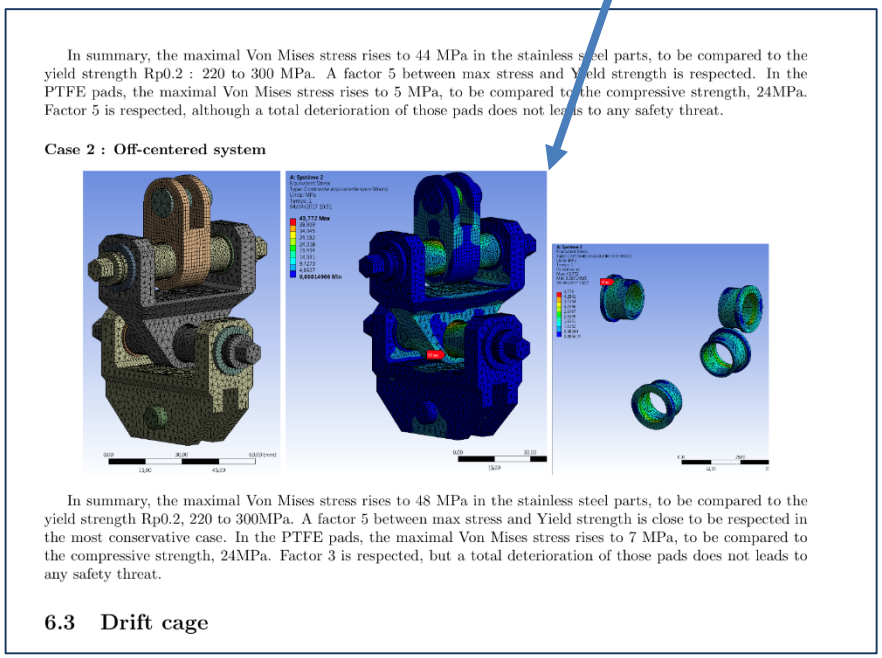
Please note that this form must be completed and sent to CERN prior to the arrival of the planned experiment. Work will not be allowed to start until this form, and any requested complementary information on safety hazards, has been completed and handed over as explained above.

Filled out by: D. Duchesneau, S. Murphy

Date: 4/05/2017

1

EDMS: 1317710 Date: Version: 4



In summary, the maximal Von Mises stress rises to 44 MPa in the stainless steel parts, to be compared to the yield strength Rp0.2 : 220 to 300 MPa. A factor 5 between max stress and Yield strength is respected. In the PTFE pads, the maximal Von Mises stress rises to 5 MPa, to be compared to the compressive strength, 24MPa. Factor 5 is respected, although a total deterioration of those pads does not leads to any safety threat.

Case 2 : Off-centered system

In summary, the maximal Von Mises stress rises to 48 MPa in the stainless steel parts, to be compared to the yield strength Rp0.2, 220 to 300MPa. A factor 5 between max stress and Yield strength is close to be respected in the most conservative case. In the PTFE pads, the maximal Von Mises stress rises to 7 MPa, to be compared to the compressive strength, 24MPa. Factor 3 is respected, but a total deterioration of those pads does not leads to any safety threat.

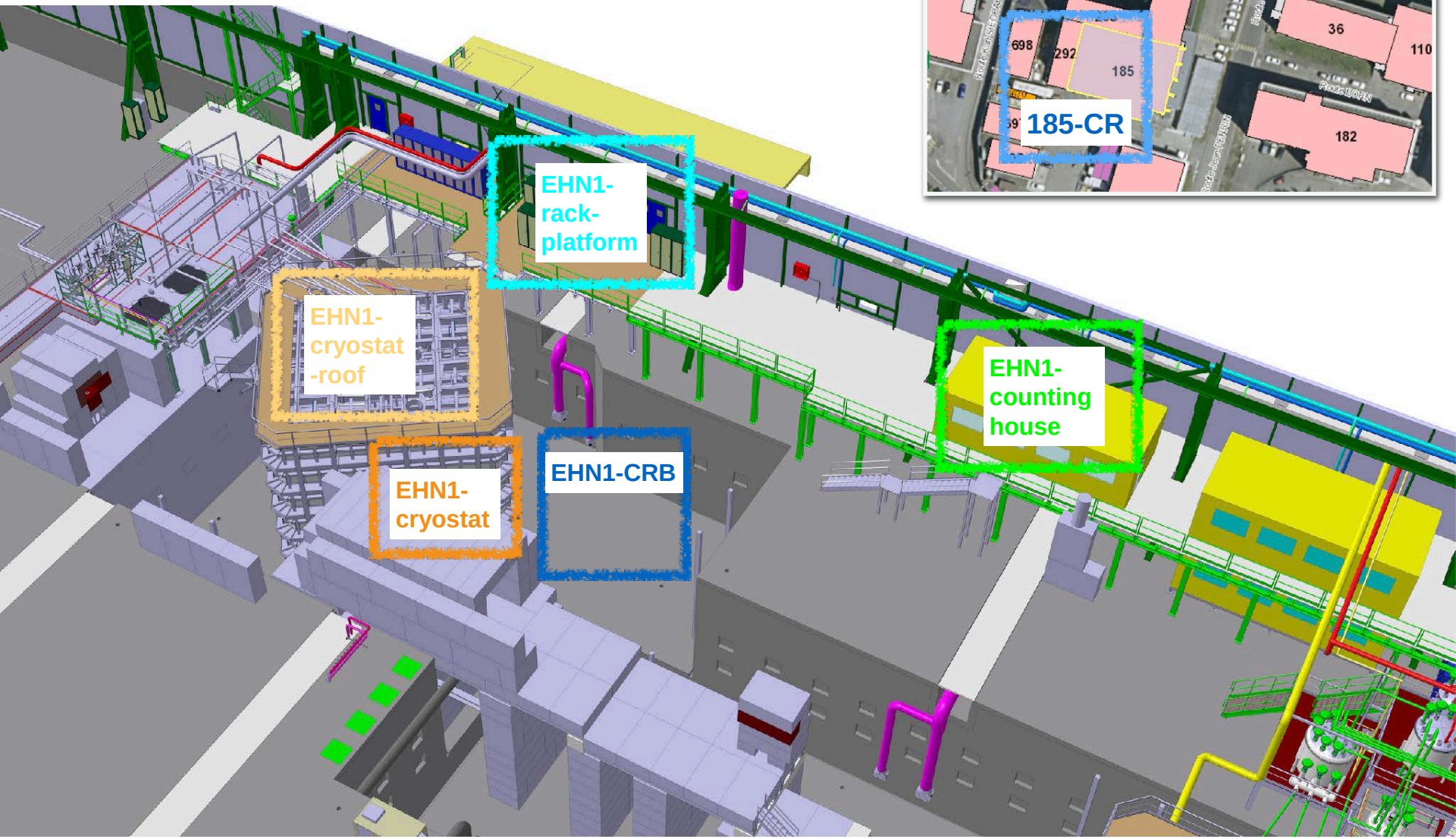
6.3 Drift cage

Had a dedicated meeting to define the calculation standards on June 2nd

Infrastructure areas, nomenclature and naming conventions

Definition of infrastructure areas

6 geographical zones.



Definition of infrastructure areas and activities

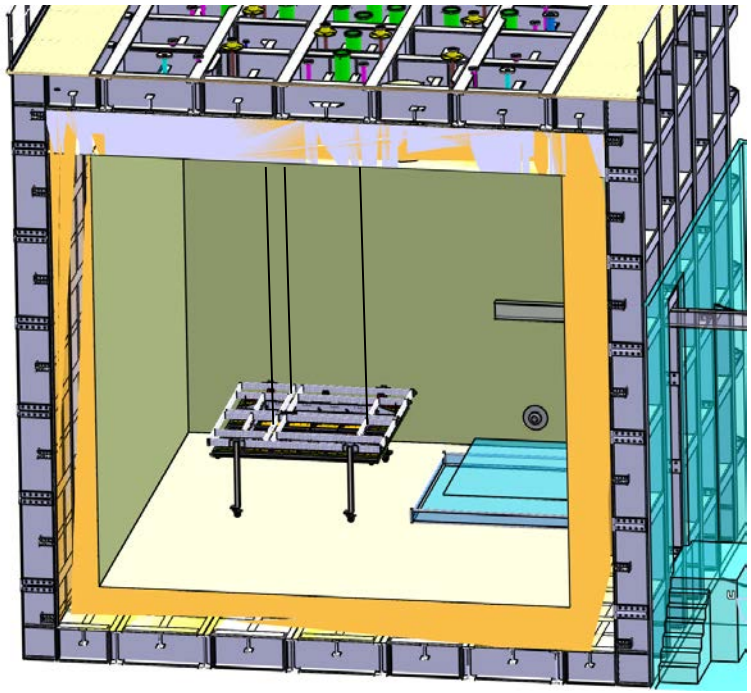
6 geographical zones.

EHN1-cryostat-roof:

- Chimneys and feedthroughs installation
- Element survey
- Charge readout crates
- Interface with cryo piping
- VHV system
- External cabling and cable trays

EHN1-cryostat:

- CRP mounting, cabling and survey and QA
- Field cage assembly, electrical connection and QA
- Cathode and ground grid installation and QA
- PMT installation and cabling and QA
- Purity monitor installation
- Slow control sensors installation and connections and QA

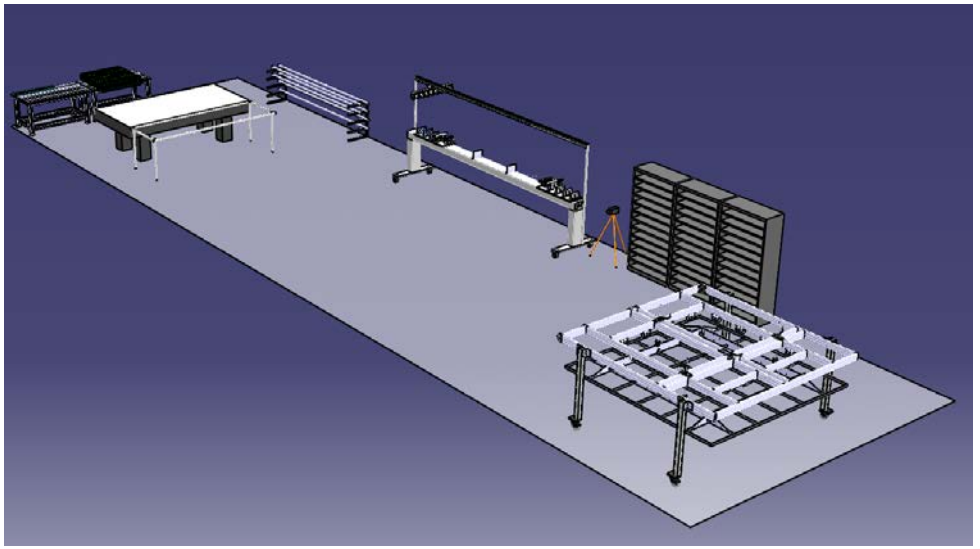


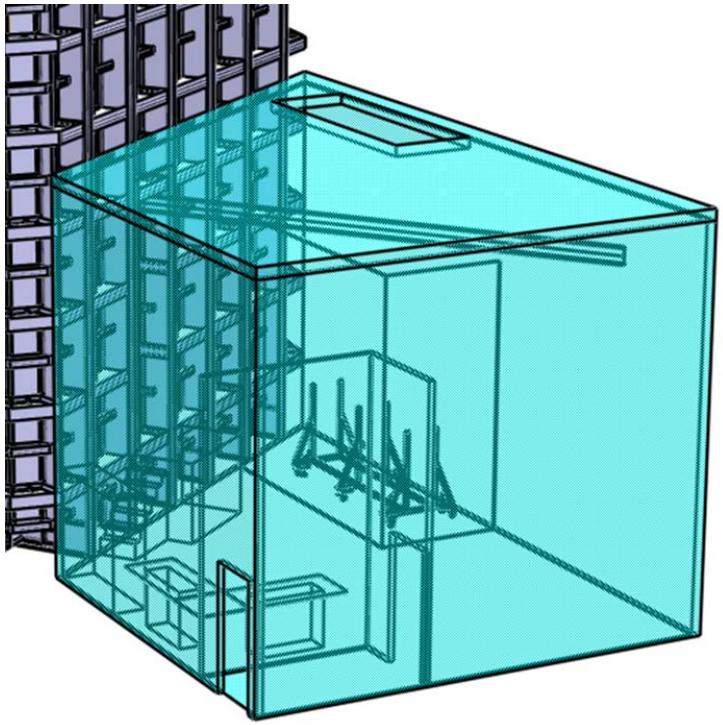
Definition of infrastructure areas and activities

6 geographical zones.

CR-185:

- LAS assembly and QA
- CRP assembly and QA
- Packing in transport boxes





EHN1-CRB:

- Reception and insertion of CRP in cryostat
- Assembly field cage submodules + QA and insertion in cryostat
- Reception and Insertion of cathode and ground grid elements

Definition of infrastructure areas and activities

6 geographical zones.

EHN1-rack-platform:

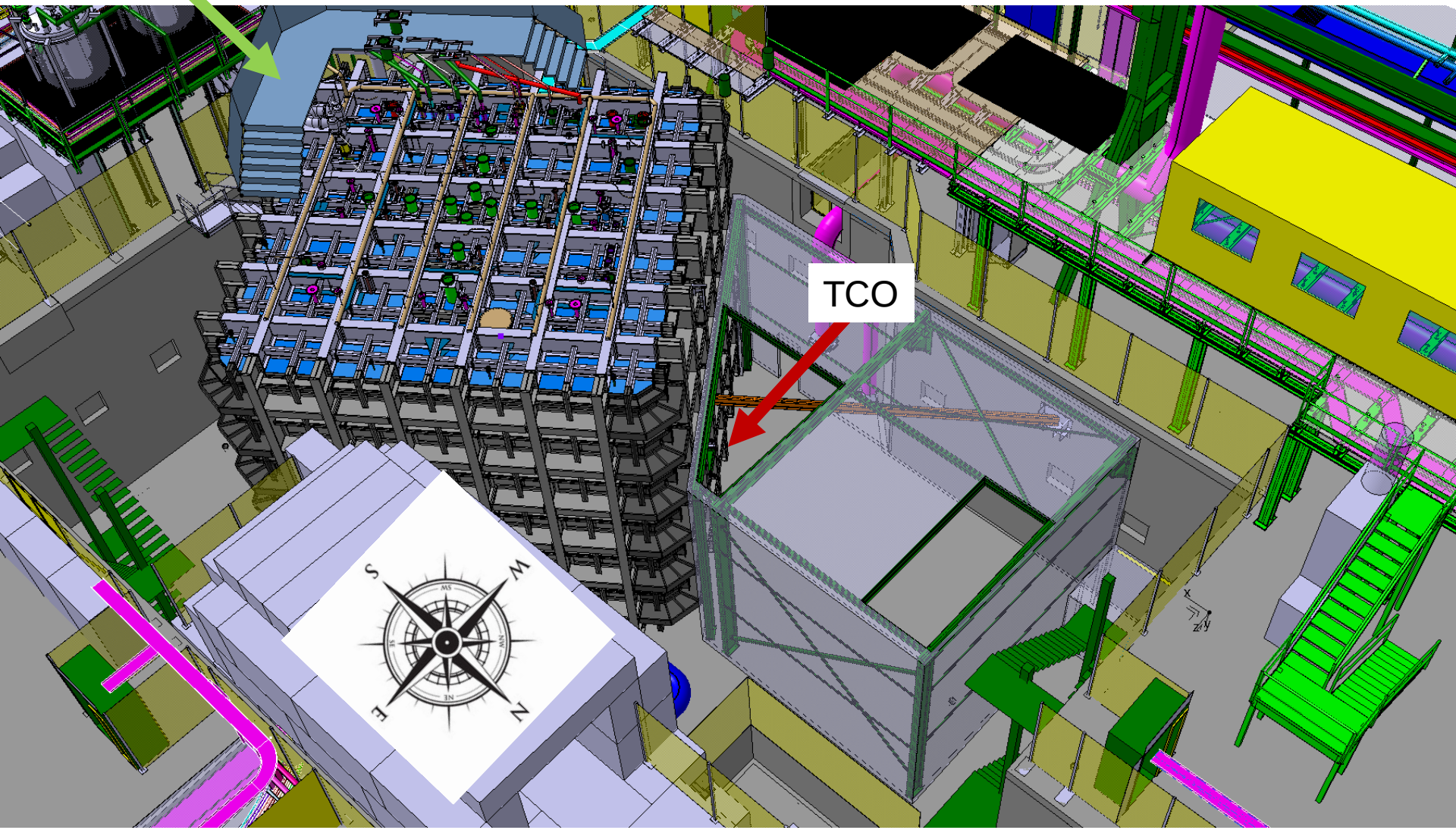
- Supervise uncabling and transport racks from 182 to EHN1
- Define power needs and electrical layout
- Manage the detector/building grounds (safety, insulating mats, ….)
- Rack design and layout
- Rack installation and cabling

EHN1 counting rooms

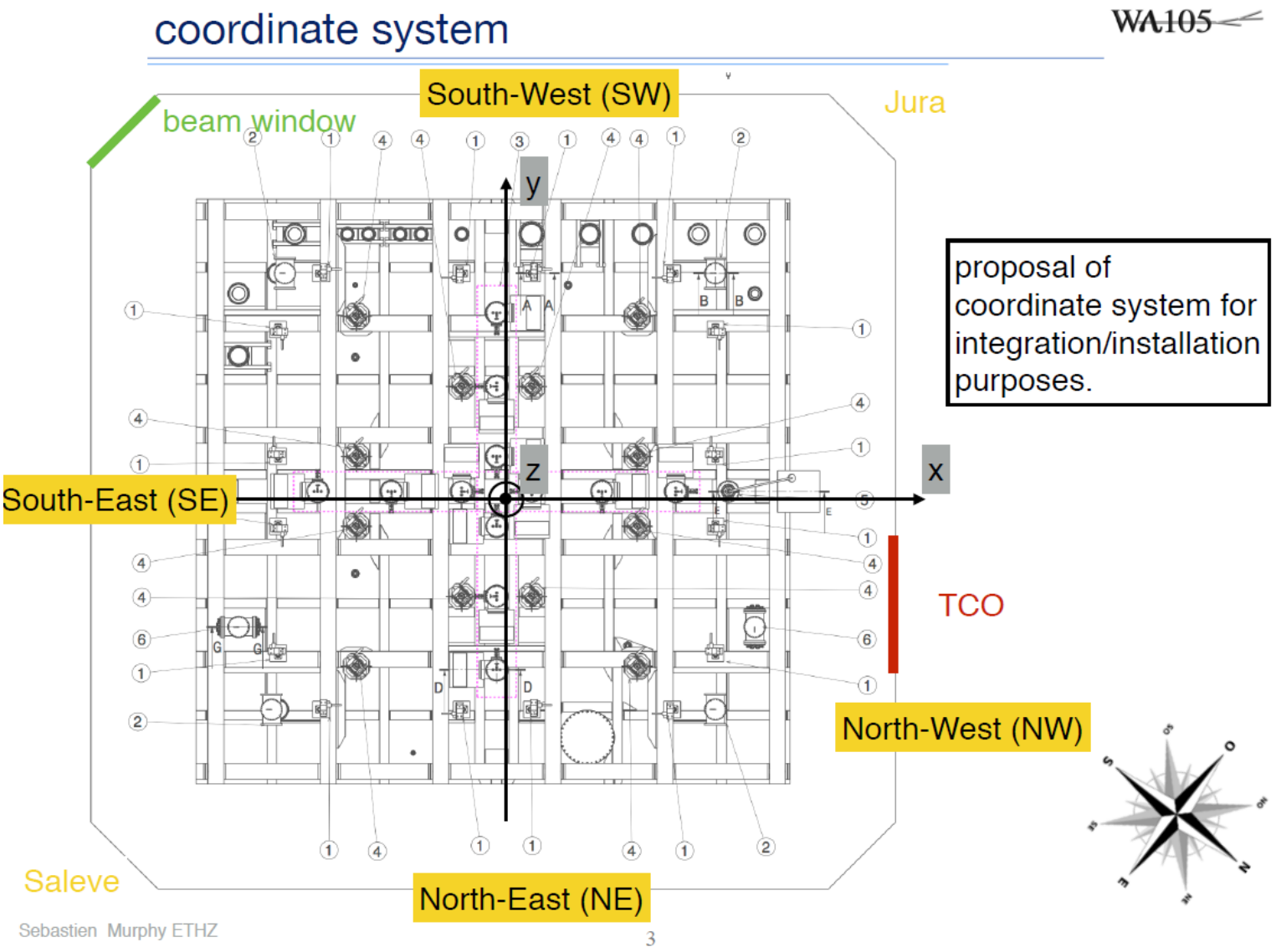
- Rack design and layout
- Define cooling power requirements
- Computing resources and network

NP02 area in EHN1

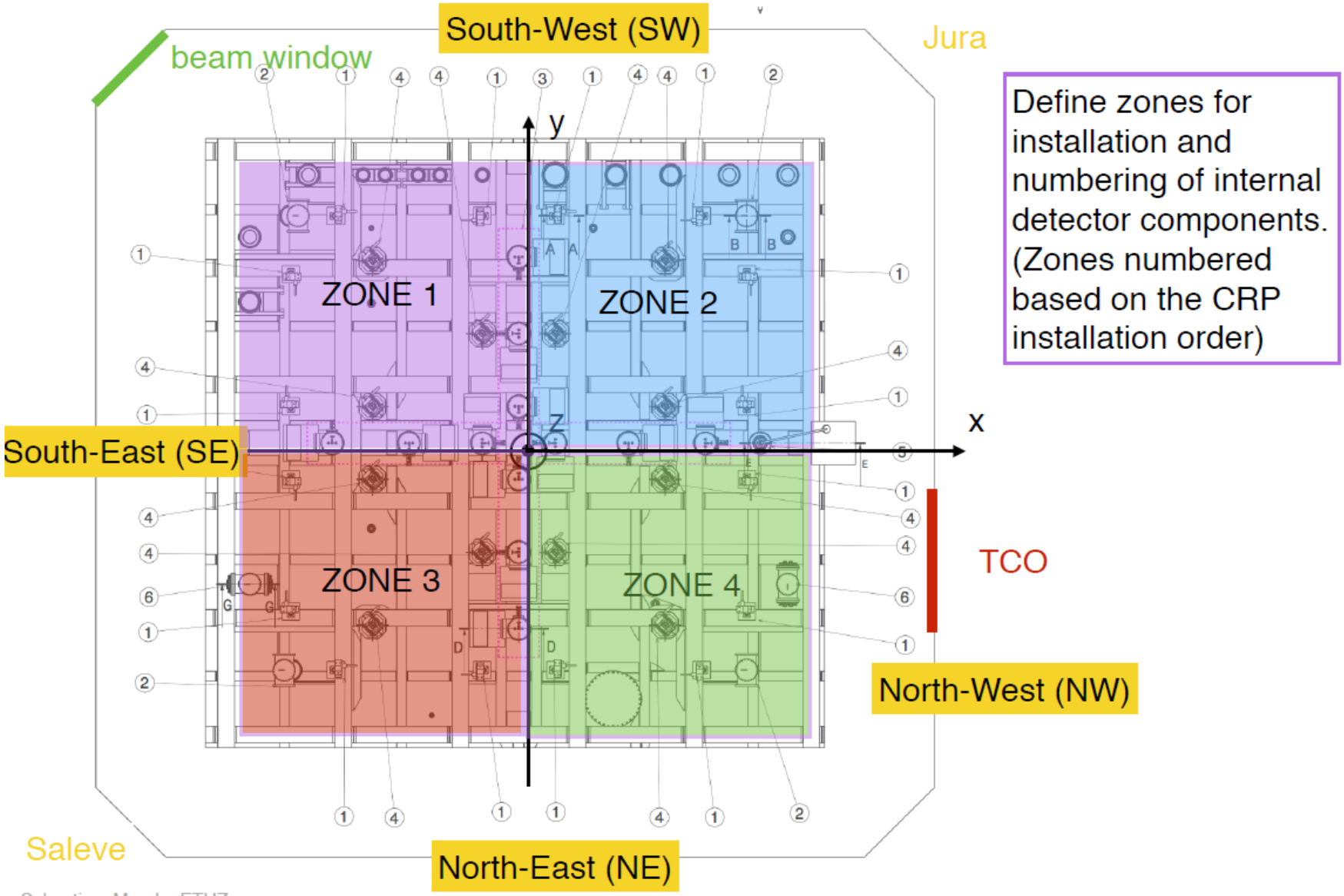
Some changes in the CRB layout for safety reasons



Convention for naming the different parts (chimneys, CRP, Field Cage modules etc….)



Nomenclature



Define zones for installation and numbering of internal detector components. (Zones numbered based on the CRP installation order)

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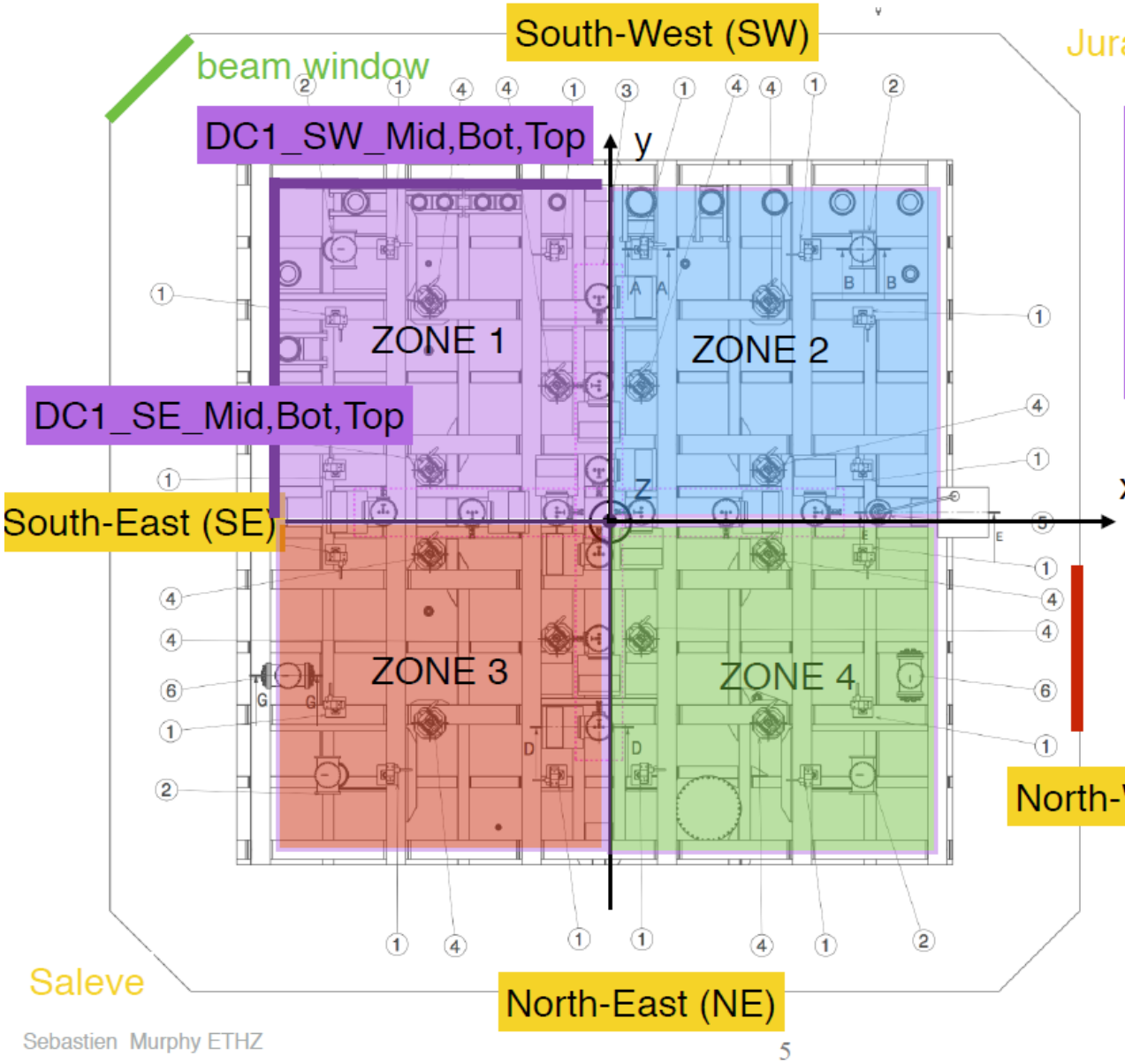
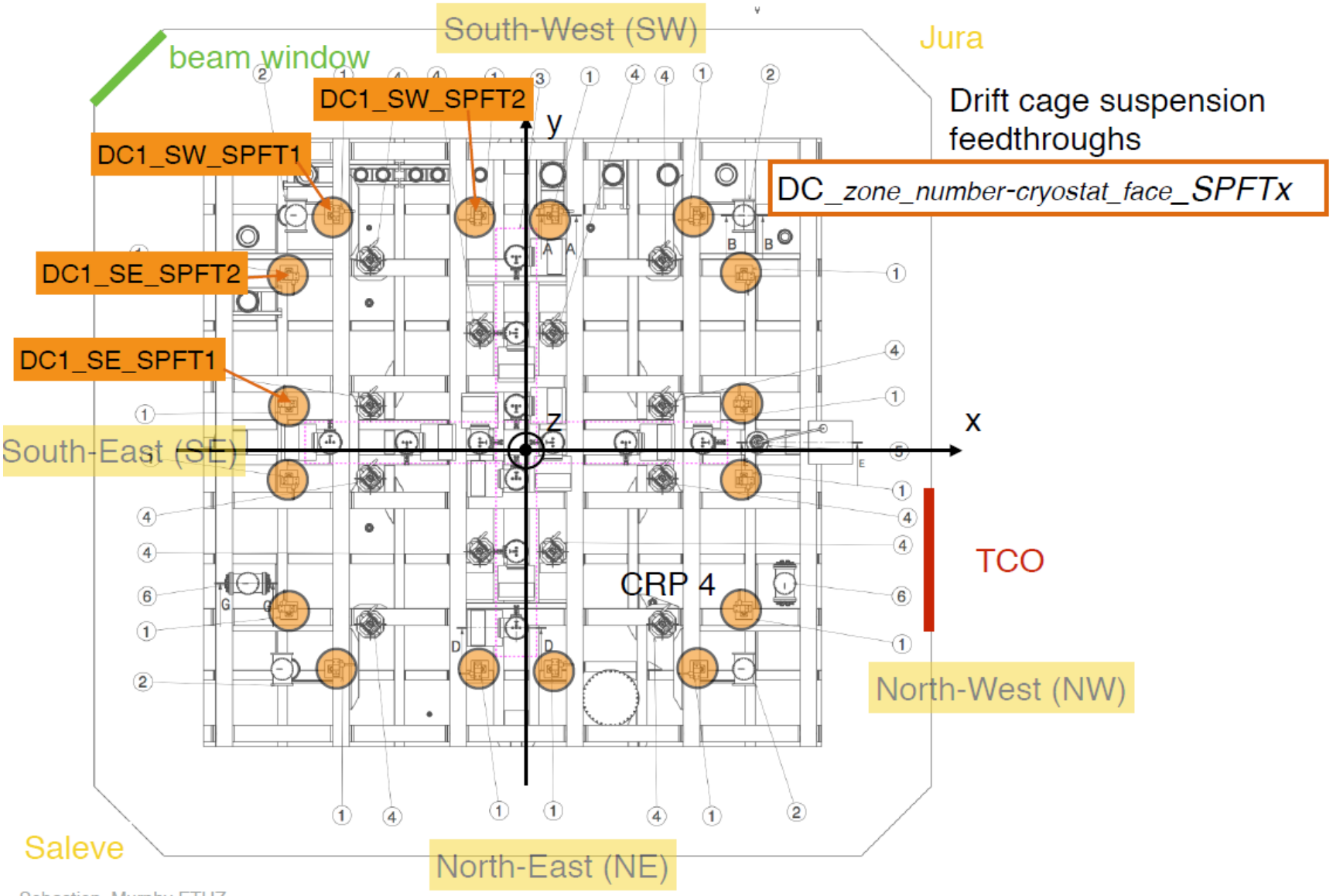
4

Nomenclature- example Drift cage modules



numbering of drift cage modules accordingly.
Try to keep to the same logic for all other detector parts

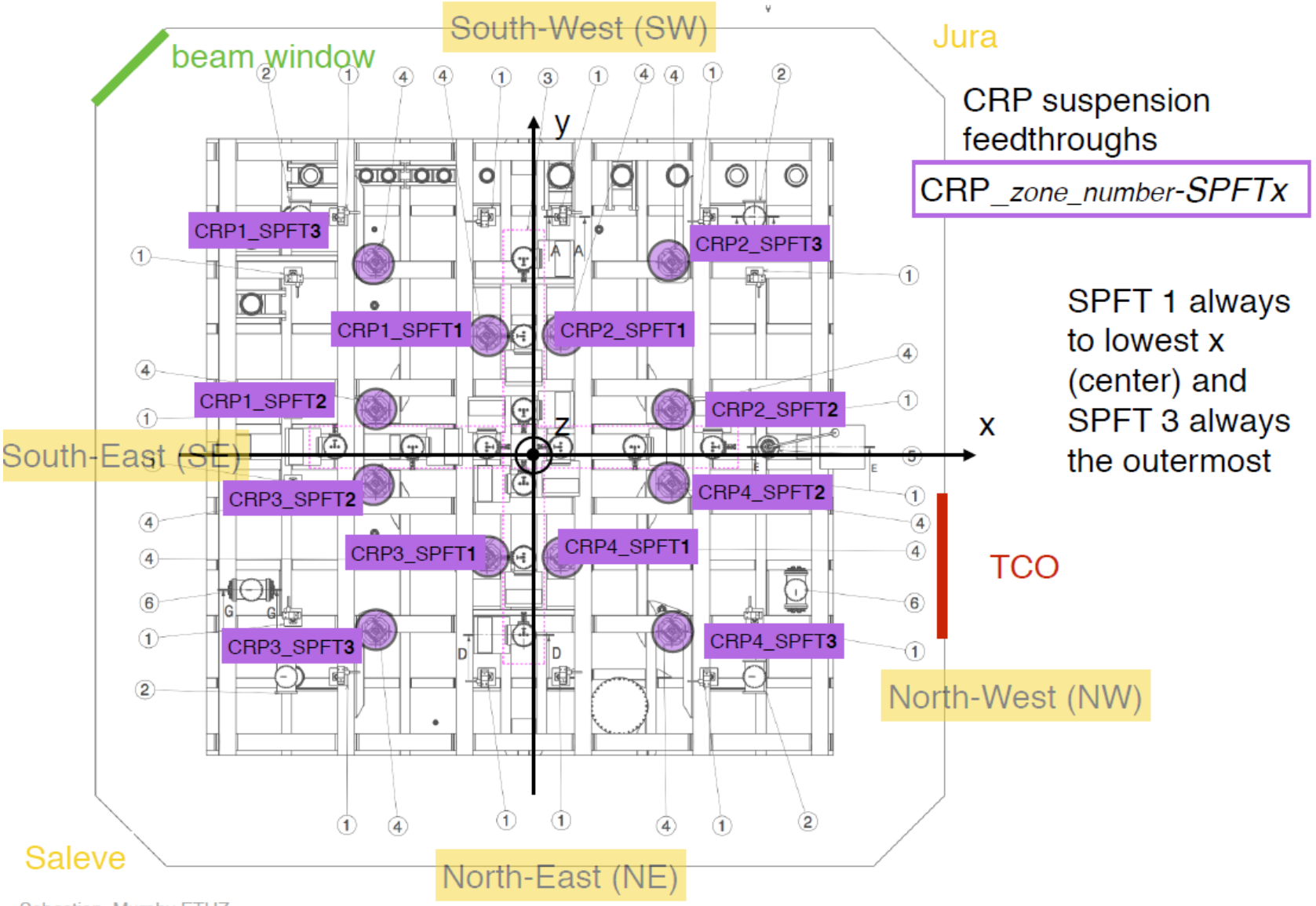
Feedthrough naming



Drift cage suspension feedthroughs

DC_*zone_number-cryostat_face*_*SPFTx*

Feedthrough naming



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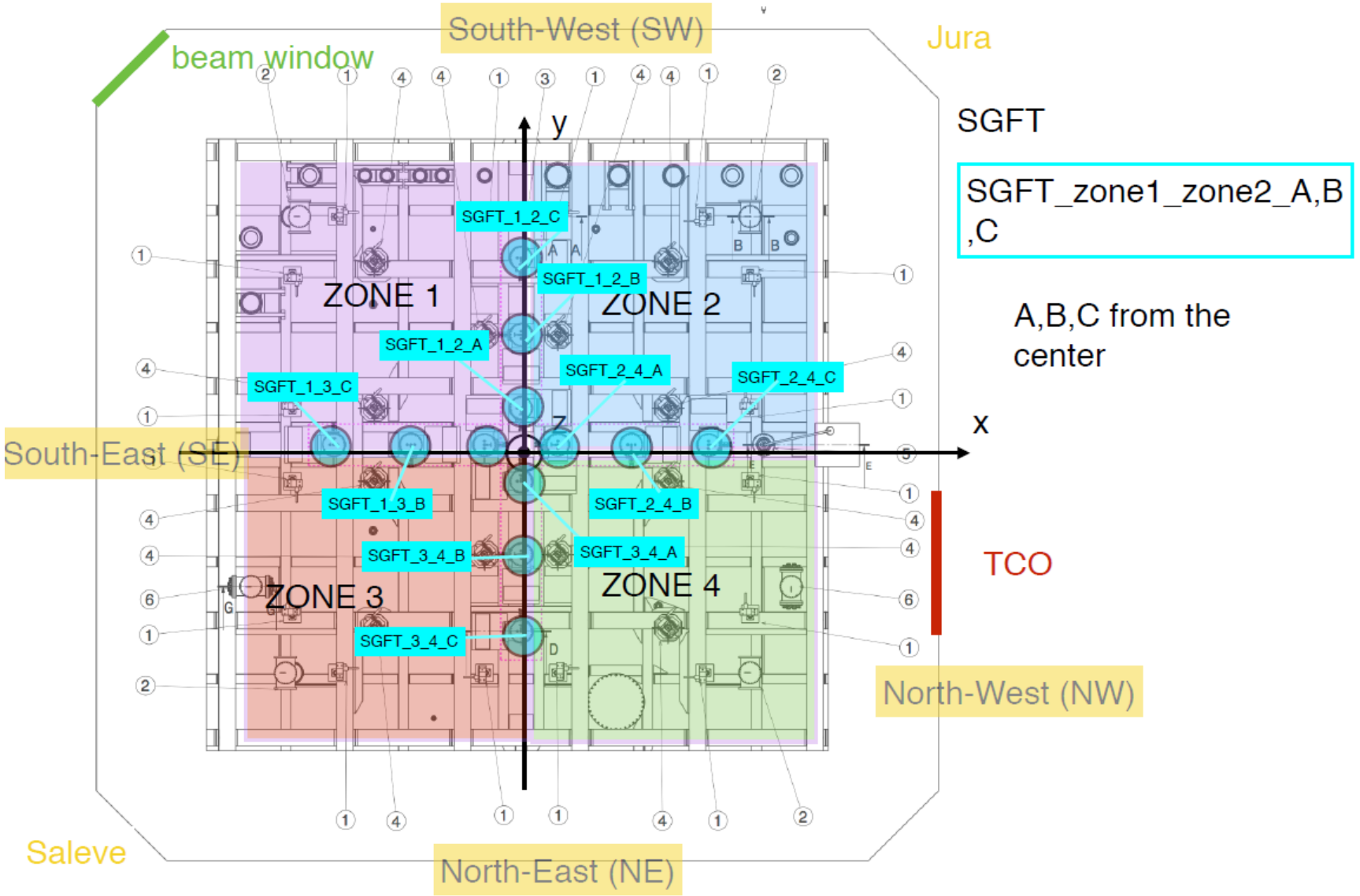
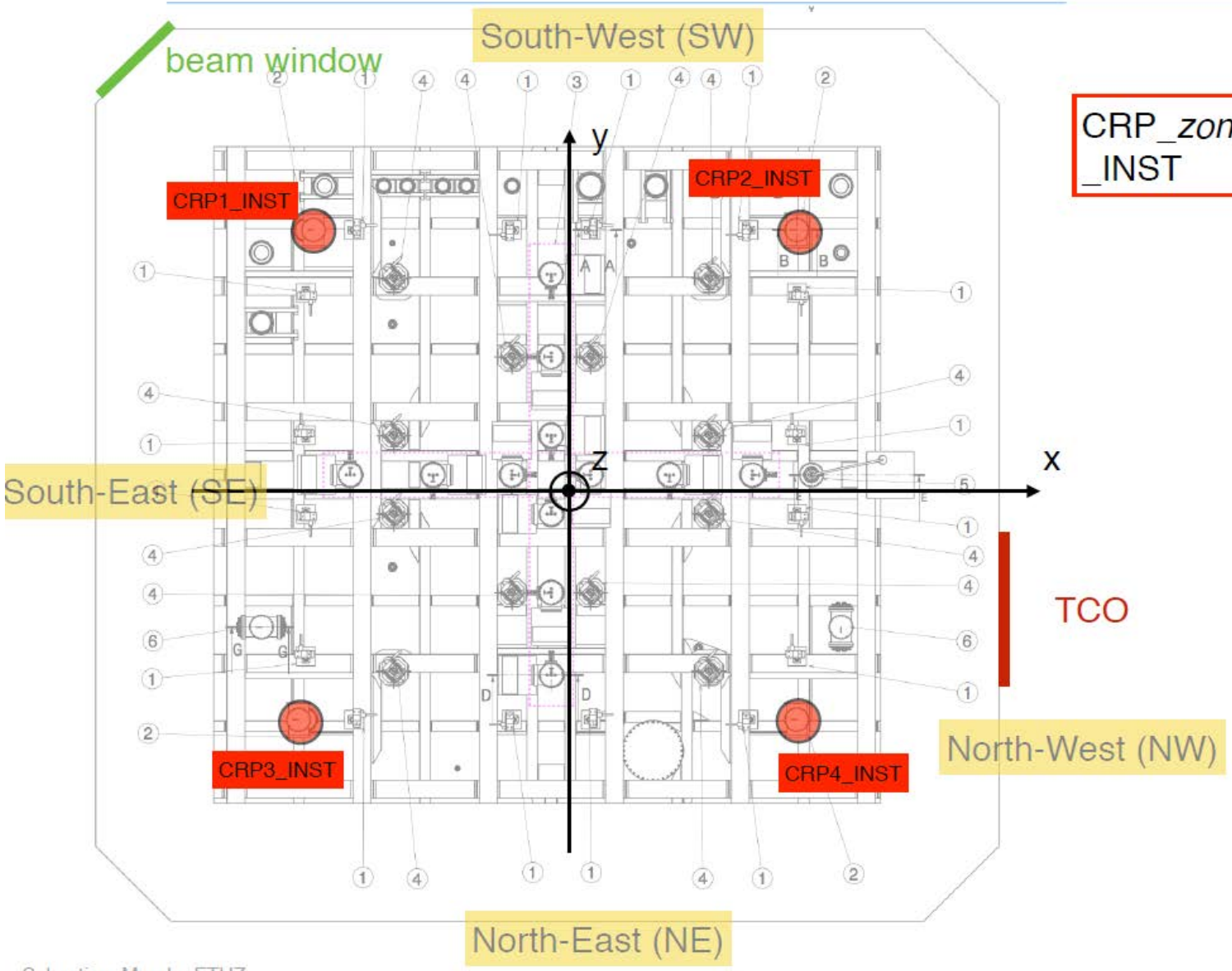
7

Feedthrough naming



Feedthrough naming



CRP_*zone_number*_INST

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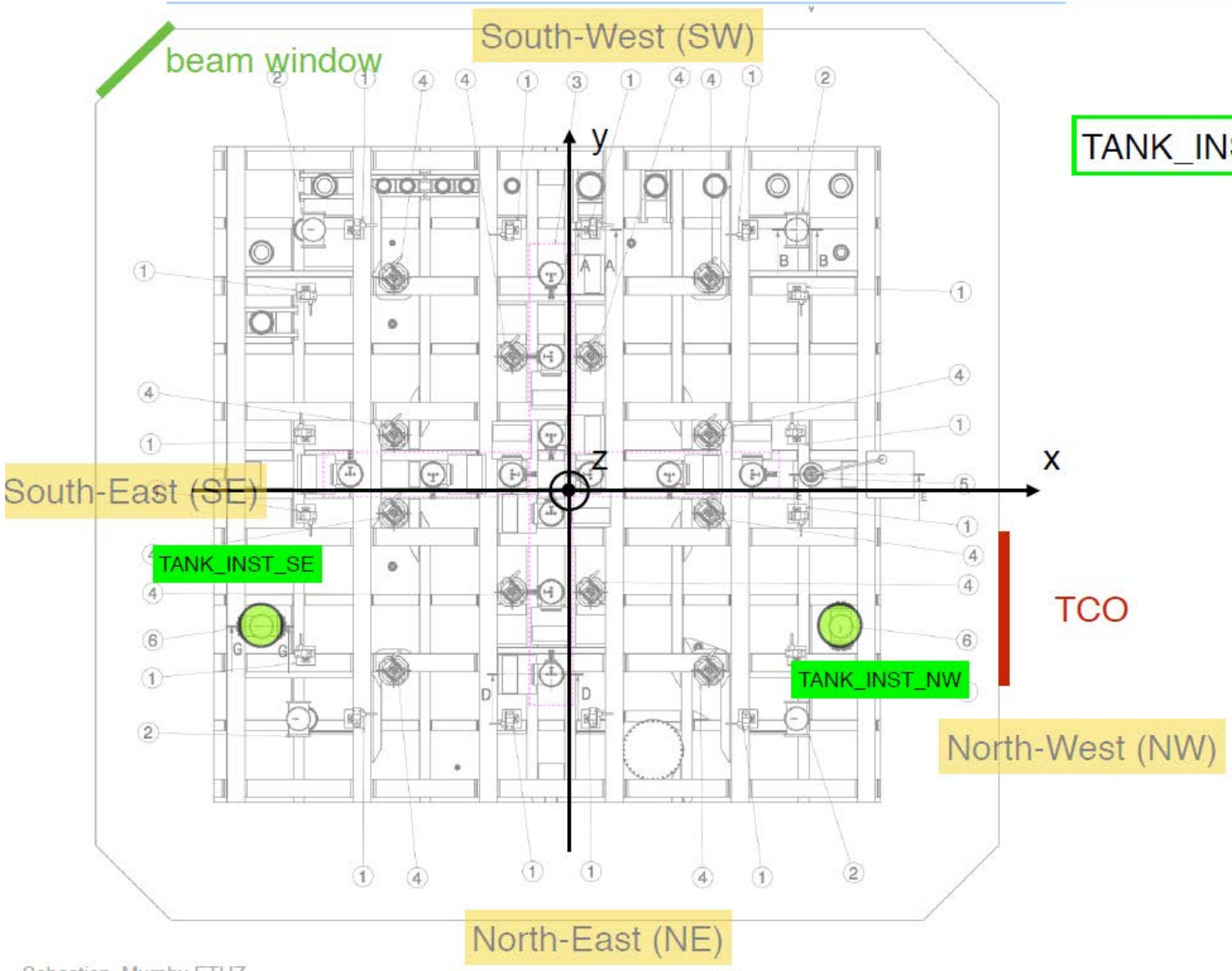
9

Feedthrough naming



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10

Status of detector construction and schedule

ProtoDUNE-DP schedule and level of advancement and details:

- Infrastructures (EHN1 cryostat, CRB, CR185) ✓
- CRP mechanical frame ✓
- CRP instrumentation ✓
- CRP LEM-Anodes ✓
- Drift cage ✓
- Cathode and ground grid ✓
- Light Readout ✓
- Charge Readout ✓ (missing details)
- Feedthroughs and Chimneys
  - TANK-INST ✗
  - CRP-INST ✗
  - SGFT ✗
  - HVFT and extension ✗
  - CRP-SPFT ✗
  - FC-SPFT ✗
- HV systems ✗
- VHV ✗
- Beam-plug ✗
- Detector slow control ✗
- Electrical distribution and grounding ✗
- External cabling and roof layout ✗
- CRT

Most of those items are included in the present MS project schedule.

ProtoDUNE-DP schedule and level of advancement and details:

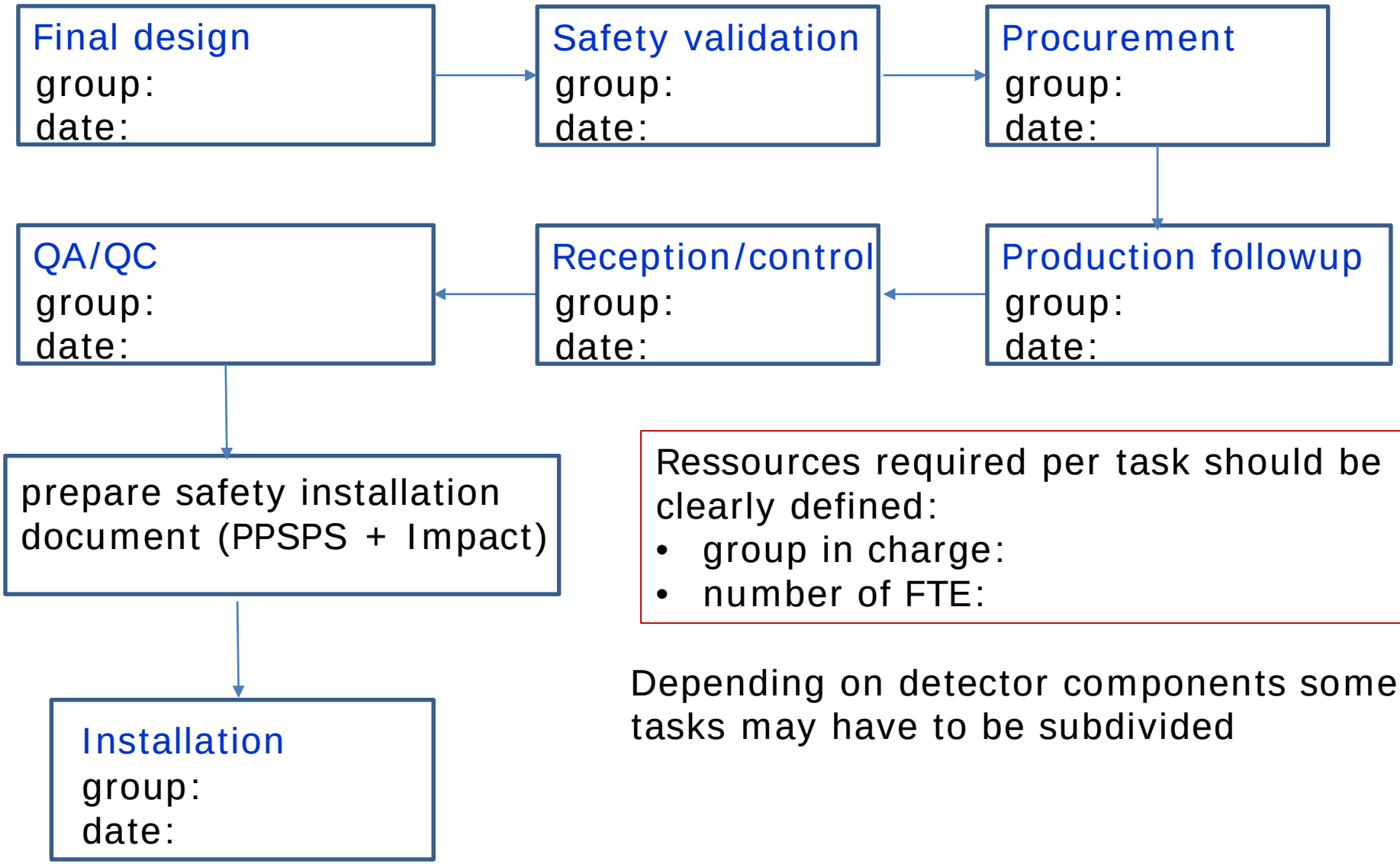
- Important: for each item Safety approval needed after design: based on FEA and load calculations when necessary. Following EuroCode standards => major work

- Consider and add the follwoing CERN NP interfaces
  - Cryogenics and cryostat,
  - Electrical distribution (EN-EL)
  - Control racks and PVSS (EP-DT)
  - External cabling
  - Counting house

Responsible groups:

- Infrastructures (EHN1 cryostat, CRB, CR185) ✓ CERN
- CRP mechanical frame ✓ LAPP
- CRP instrumentation ✓ ETHZ
- CRP LEM-Anodes ✓ CEA - ETHZ
- Drift cage ✓ UTA- CERN
- Cathode and ground grid ✓ ETHZ
- Light Readout ✓ CIEMAT, APC, LAPP
- Charge Readout ✓ IPNL - KEK
- Feedthroughs and Chimneys
  - TANK-INST ✗ BERN
  - CRP-INST ✗ ??
  - SGFT ✗ ETHZ
  - HVFT and extension ✗ ETHZ
  - CRP-SPFT ✗ LAPP
  - FC-SPFT ✗ ETHZ
- HV systems ✗ ETHZ - ??
- VHV ✗ ETHZ – CERN
- Beam-plug ✗ ??
- Detector slow control ✗ ETHZ - CERN
- Electrical distribution and grounding ✗ CERN
- External cabling and roof layout ✗ CERN – ETHZ
- CRT BERN

Detector component integration steps (need inputs from responsible groups):



Ressources required per task should be clearly defined:

- group in charge:
- number of FTE:

Depending on detector components some tasks may have to be subdivided

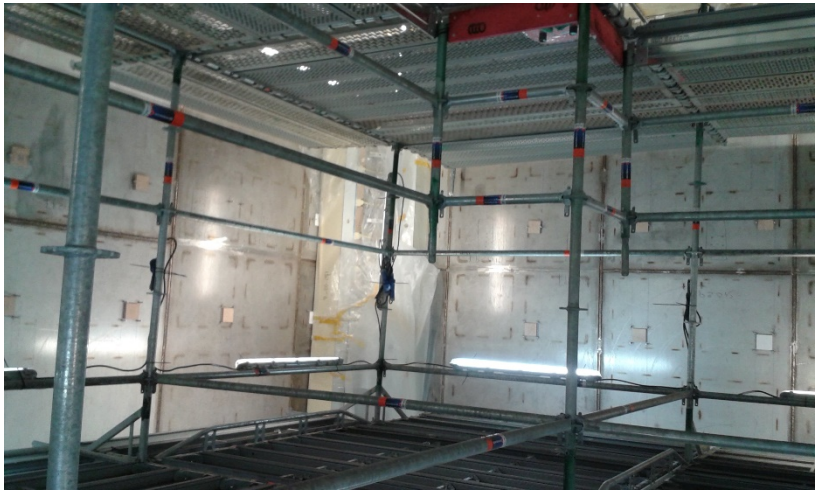
Detector component and integration steps will be reviewed and updated at each integration meeting

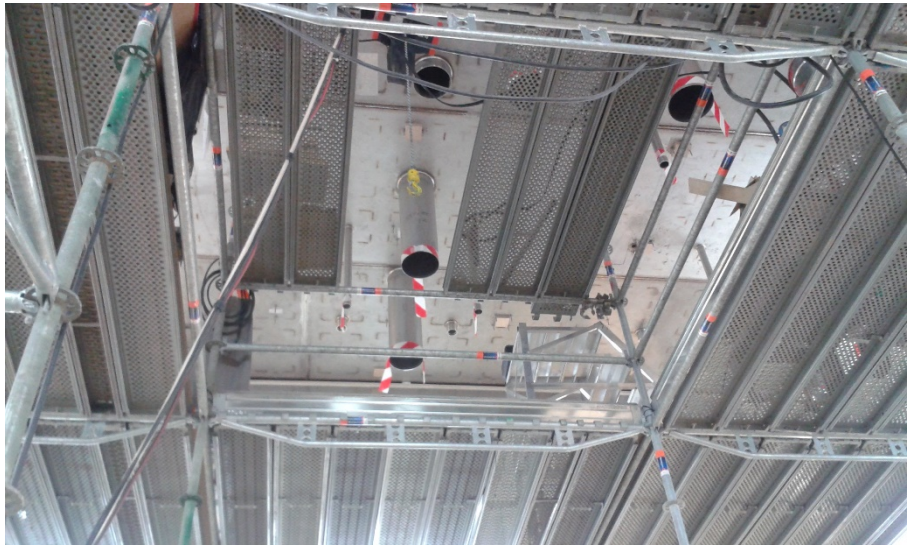
Status of EHN1 infrastructure:

Latest milestones from NP as of today:

- Insulation panel installation under way
- Membrane completed: Summer 2017
- CRB preparation: July 2017
- Internal piping: arriving mid-aug. 2017, 3 weeks installation
- Temporary floor: 1 week after installation

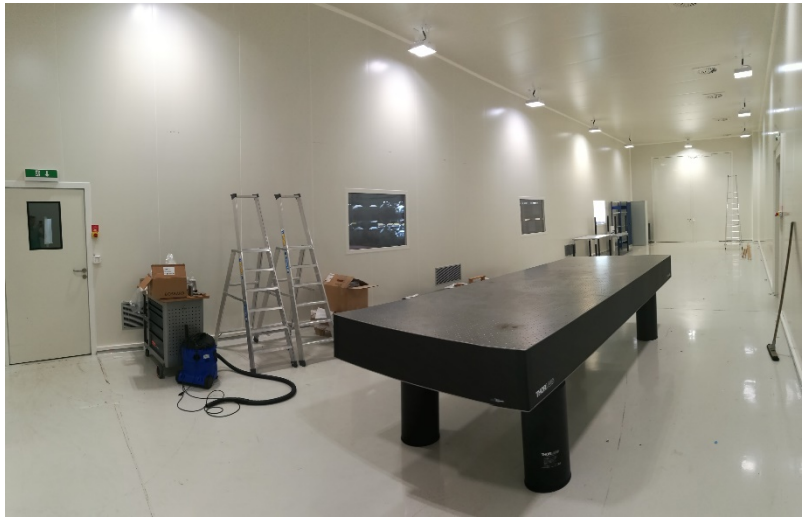
⇒ Cryostat may be finished with CRB installed **in September**





Building 185 Clean Room

- ready to be used since April; fully accessible since 12/06/17
- Some CRP assembly material already received

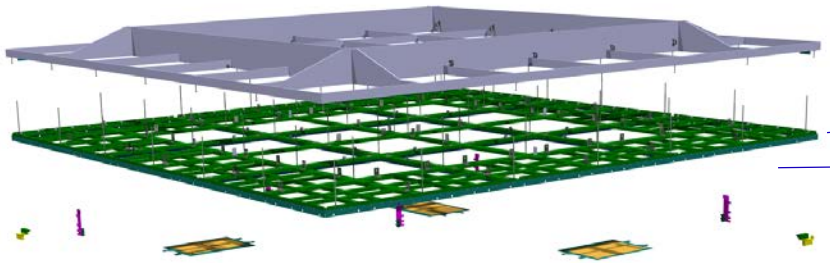


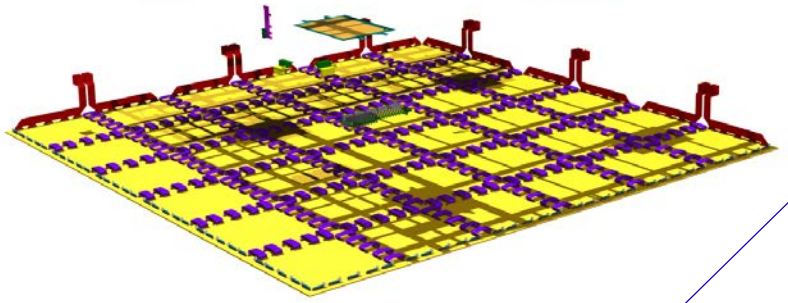
Next steps:

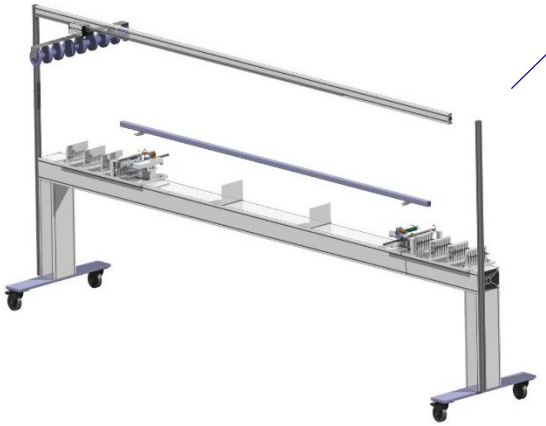
- Cleaning of the room + design system at the main door to keep the room area cleaned when CRP are transported
- Install the grid wire assembly tool end of June
- Perform assembly tests and control of grid elements in July

Later (from July): receive CRP frame and G10 elements and prepare the first CRP

CRP parts ordering







Already ordered :

- *Invar frames*
- *G10 frames*
- *Extraction grid*
- *Extraction grid tooling (received)*

What is missing :

(Small ordering delay, waiting for HSE validation)

- *Small machined parts for CRP assembly*
- *Supporting structure (transport box)*

CRP : status :

CRP parts ordering

Part	Delivery	Manufacturer	Status
Invar frames	First frame in mid September	SDMS	Material delivered to SDMS, first validation model in construction.
G10 Frames	Mid July	Von Roll, Isotac	- All G10 frames in production - G10 combs in production with instrumentation supports.
Extraction grid	Few weeks	Sadev Inox, Wurth	- 40 km of Ø100µm wire will be received soon - PCB plates are in production
Extraction grid tooling	Last parts delivery imminent		Few parts will be received next week, construction of the tooling will be done asap. First tests of real scale brazing foreseen asap.
Distance Meters	Last parts in few weeks	RS, Mouser …	Electronical parts received, waiting for PCBs to test.

Other parts relative to lifted loads are waiting for HSE validation.
Production delays of those parts are not critical (days to few weeks).

LEMs + anode

- LEMs:
- order for the first 80 LEMs was placed by CEA to ELTOS on May 25
- two first LEMs (preproduction) should arrive at CEA end of next week
- CEA go to visit ELTOS on-site production on July 5th
- Expect at least first 12 LEMs at the end of July
- ELTOS closed for 2 weeks in August but should no have any impact on the initial planning of 6 per week
- QA/QC @ Saclay operational will be able to clean and test with source first two LEMs that arrive end of next week.

Anodes:
- order placed by ETH this week, under approval at CERN
- Final gerber file validated by key people
- expect to receive first samples at CERN middle of July (need to organise storage)

LAS (LEM-anode-sandwich)
-first test assembly at CEA with new design of spacer planned at the end of this month.
-need to place order for spacers + screws

Drift cage - status

profiles:

- 3 m bent + coated profiles: received first prototypes at CERN last week visual inspection ok.
- A prototype batch of 33 bent profiles will arrive at CERN soon (2-3 weeks) will be sent to UTA for test assembly and validation on module 0.
- received a quote for the full production of 1'000 profiles (which includes 216 spare profiles, enough for at least 3 sub-models + 10% potential damage during installation)
- Expected delivery time September 30th (need storage place)

- clips:
  - Received first coated prototype clips from MIFA, tested clipping and visual inspections ok.
  - Full order of 1'200 clips has been placed should arrive at CERN in coming weeks (784 are needed)
  - clip-insert + screws: designed needs to be produced.

- FRP I-beams+ screws+nuts:
  - order sent out (including spares for 3 submodules), material at vendor for processing around next week
  - first shipment at UTA expected mid-July

Drift cage - status

electrical:

- modification of the divider circuit design completed early-mid next week
- testing and certification of components in progress
- bare boards delivered 3 weeks after that
- bare boards+ components certified mid August
- soldering of component on boards mid-September
- certification (warm+cold) + final installation test on module 0 of each final boards middle October
- ship to CERN not later than November.

Drift cage @ CERN

checked and measured delivered bent profiles.
All ok, within tolerance

MIFA®
ALUMINIUM PRECISION EXTRUSION

1.	**Description**	:	**Corner Proposal / Mifa 39098 Mifa art15820**
	Drawing	:	**Corner Proposal Rev. : -**
	Material	:	EN 573-3 AW **6060-T4** acc. EN 755-2
	Surface	:	SURTEC 650
	Length	:	As drawing
	Extrusion tolerances	:	EN12020-2 unless otherwise agreed

Option 1 : tolerances on the length after bending : 30±2mm and 2955±2mm

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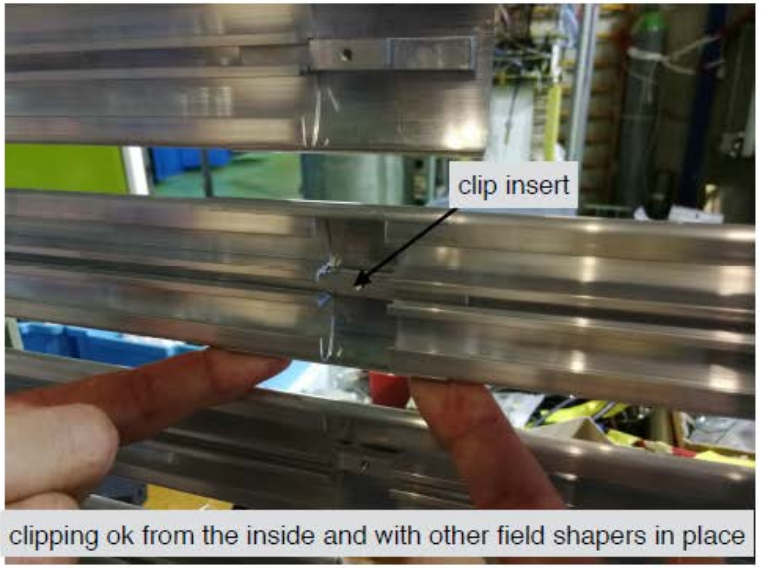
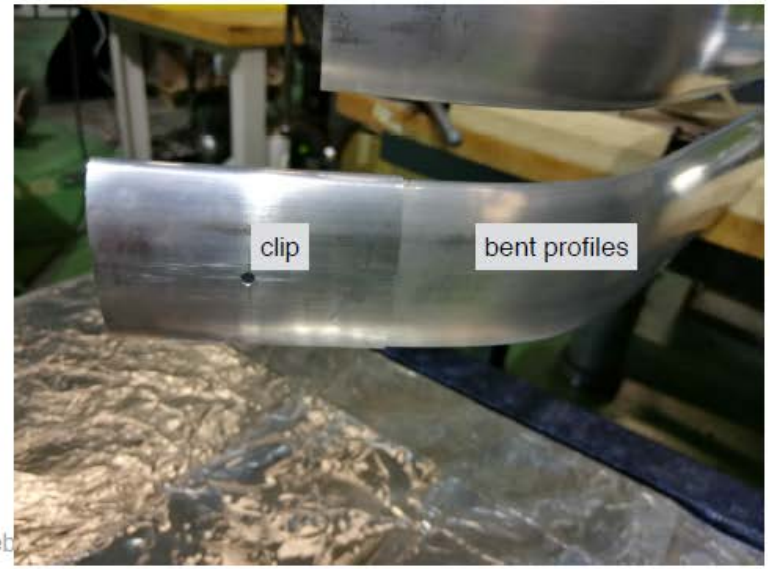
15

Drift cage @ CERN

test of clipping and bent profiles



clipping ok from the inside and with other field shapers in place



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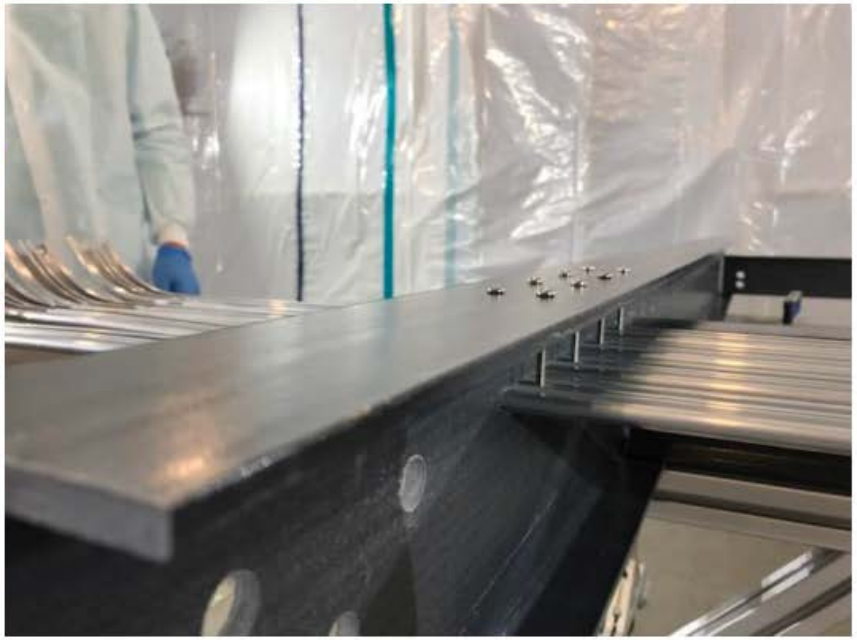
Drift cage @ UTA



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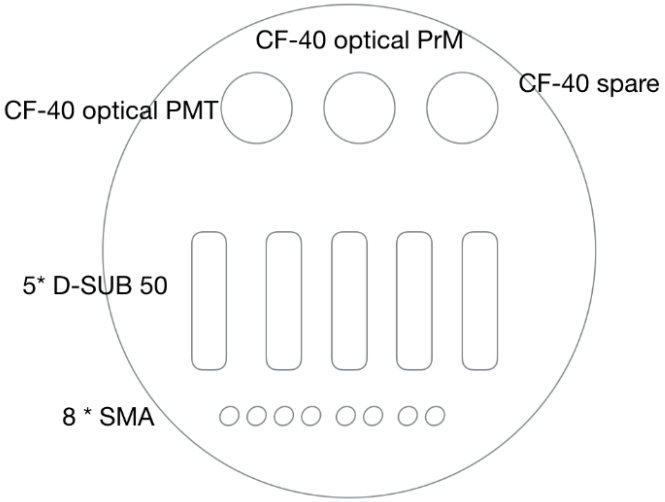
17

TANK_INST: PMTs HV+optical fibers + slow control=> 2 elements



Tasks:

- Final design: end June 2017
- Procurement: July 2017
- Pre-Assembly/control: Sept. 2017
- Installation on top of cryostat: Oct. 201

Ressources/task:

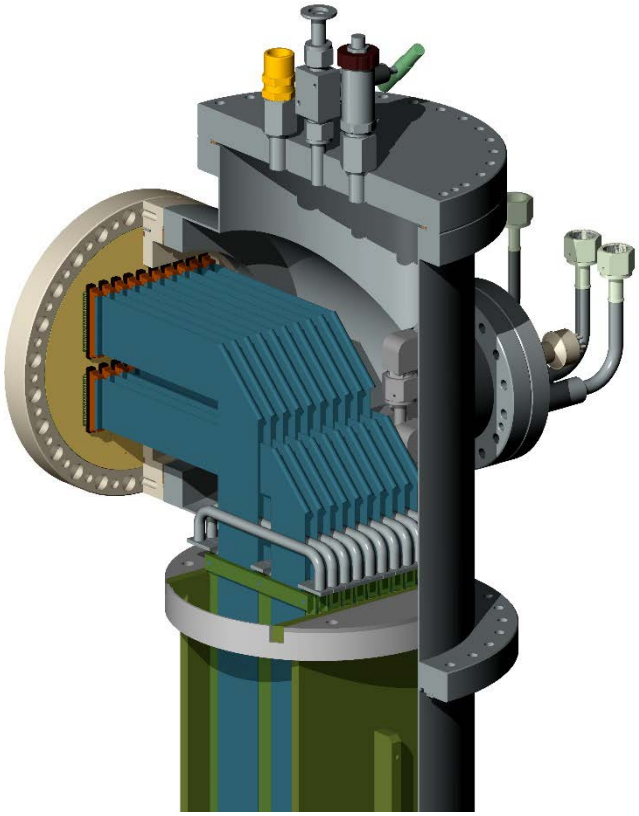
- group in charge: Bern (design and procurement); CERN technician (installation?)
- number of FTE:

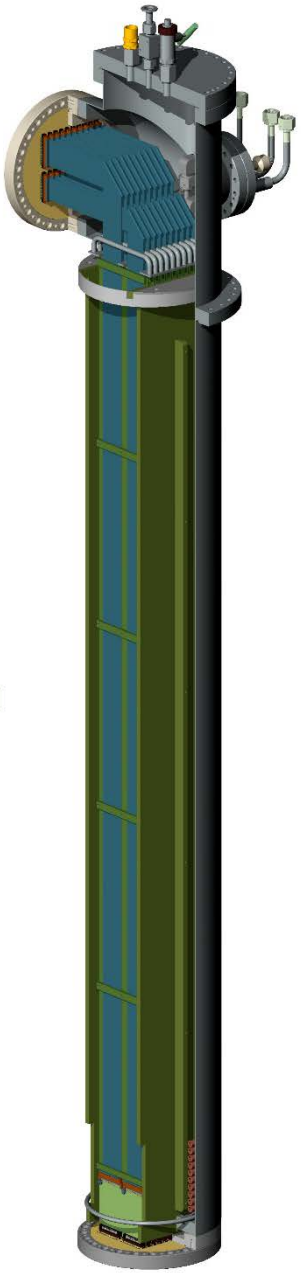
SGFT: Signal Feedthroughs => 12 elements

SGFT includes: PCB flanges + connectors, internal cables + connectors + blades (FE cards are included in Charge readout item)

Tasks:

- Final design including PCB flanges: *feedback from 3x1x1*; beg of July
- Safety validation: in process but will take time.
- Procurement: August with 2 firms in parallel
- Proto for design validation: sept 2017
- Reception of the full set: Dec. 2017





SGFT: Signal Feedthroughs => 12 elements

Tasks:

- Warm flange: gerber +production + connector soldering+testing: 4 months
- Cold flange: gerber + production + connector soldering+testing: 4 months

- Purchase of all charge readout connectors (KEL + others (VHDCI, SMA) => should be available for soldering
- Blade + cable preparation: from January (4 weeks)
- Chimney internal cabling (blade insertion,...) and electrical continuity tests in parallel 4 weeks
- Chimney closure and vacuum certification of each assembled chimney (need manpower) +2weeks
- Second Electrical tests under vacuum
- Bring to EHN1 and installation on top of cryostat: (kept in vacuum) March 2018

Warning: this estimate is not finalised yet! Should be optimised but it is on a critical path

Purity monitors

2 elements: connected through the TANK-INS
Put the cables before FC installation

Tasks:

- Final design: including feedback from 3x1x1=> Nov. 2017
- Procurement: Dec 2017
- Tests at UCL with cables: December 2018
- Tests in vacuum at CERN 2 weeks in bld 182 January 2018
- Install cables in cryostat: January 2018
- Installation in cryostat: March 2018 (few days)

Ressources:

- group in charge: UCL
- number of FTE: 1

Purity monitors

2 elements: connected through the TANK-INS
Put the cables before FC installation

Tasks:

- Final design: including feedback from 3x1x1=> Nov. 2017
- Procurement: Dec 2017
- Tests at UCL with cables: December 2018
- Tests in vacuum at CERN 2 weeks in bld 182 January 2018
- Install cables in cryostat: January 2018
- Installation in cryostat: March 2018 (few days)

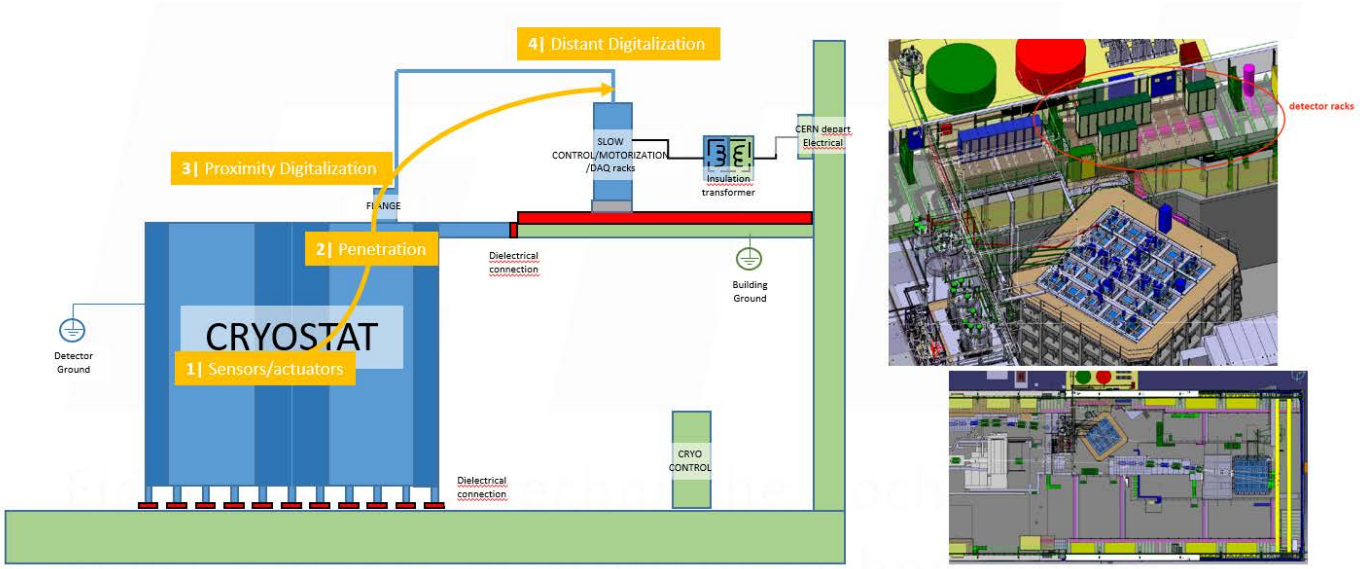
Ressources:

- group in charge: UCL
- number of FTE: 1

External cabling and roof layout

Sensors/actuators list is close and well define.
Except few systems, data acquisition and control has been also defined so cabling can be now estimated and integrated.

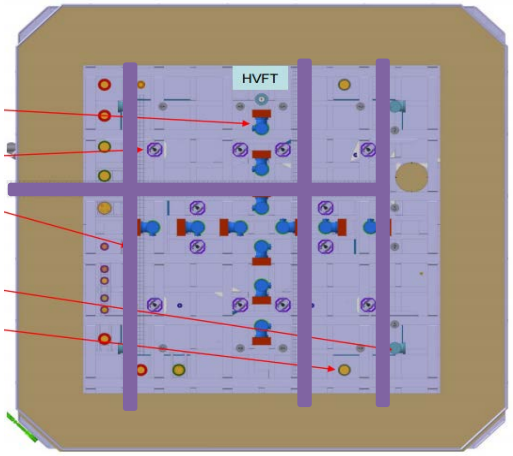
List of cables and list of boxes which are needed has been propagated by email to the CENF-WA105-INTEGRATION mailing list. We still wait last systems not totally define in term of cabling and size to finish integration on roof/cryostat GND and start to define the campaign of cabling.



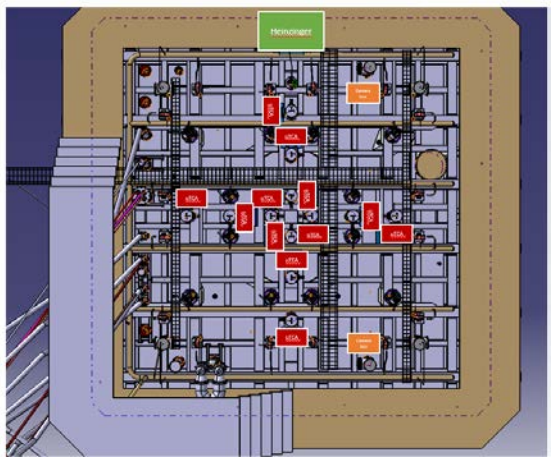
Acquisition and control principle on the cryostat ground

Please answer Yann's email by June 29th

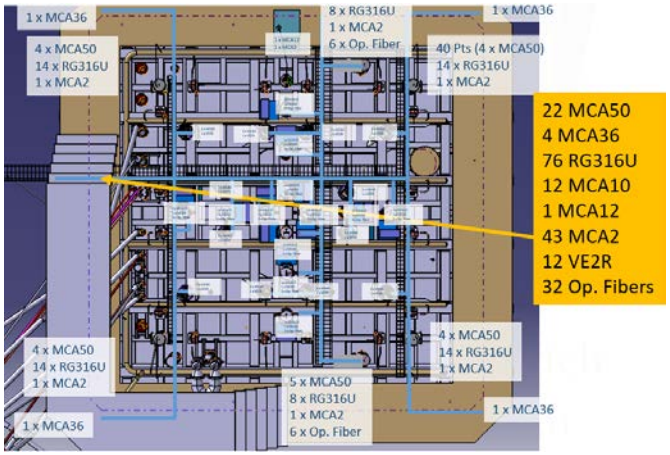
External cabling and roof layout



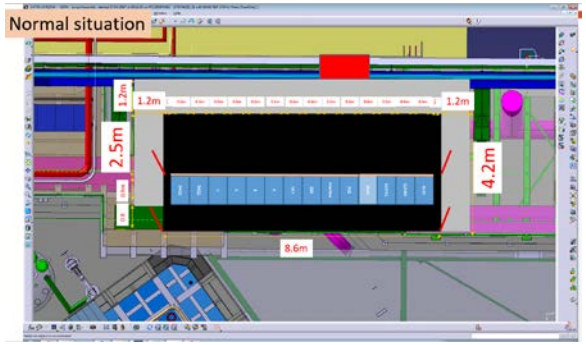
GND integration



Boxes integration

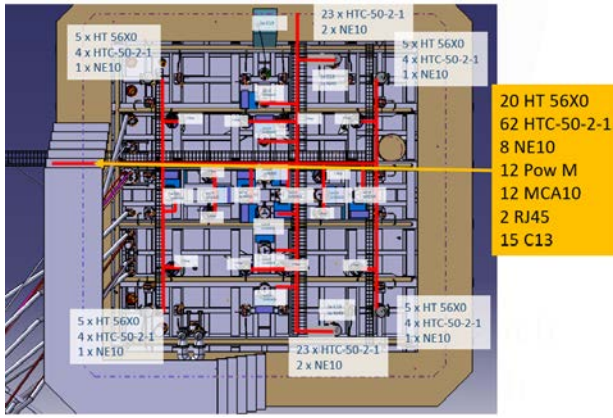


Cable tray (signal+fiber)



Remote DAQ/SC

Cable tray proto. (signal)



Cable tray (power)

For some components, tasks need to be defined and developed in more details in order to implement them in schedule

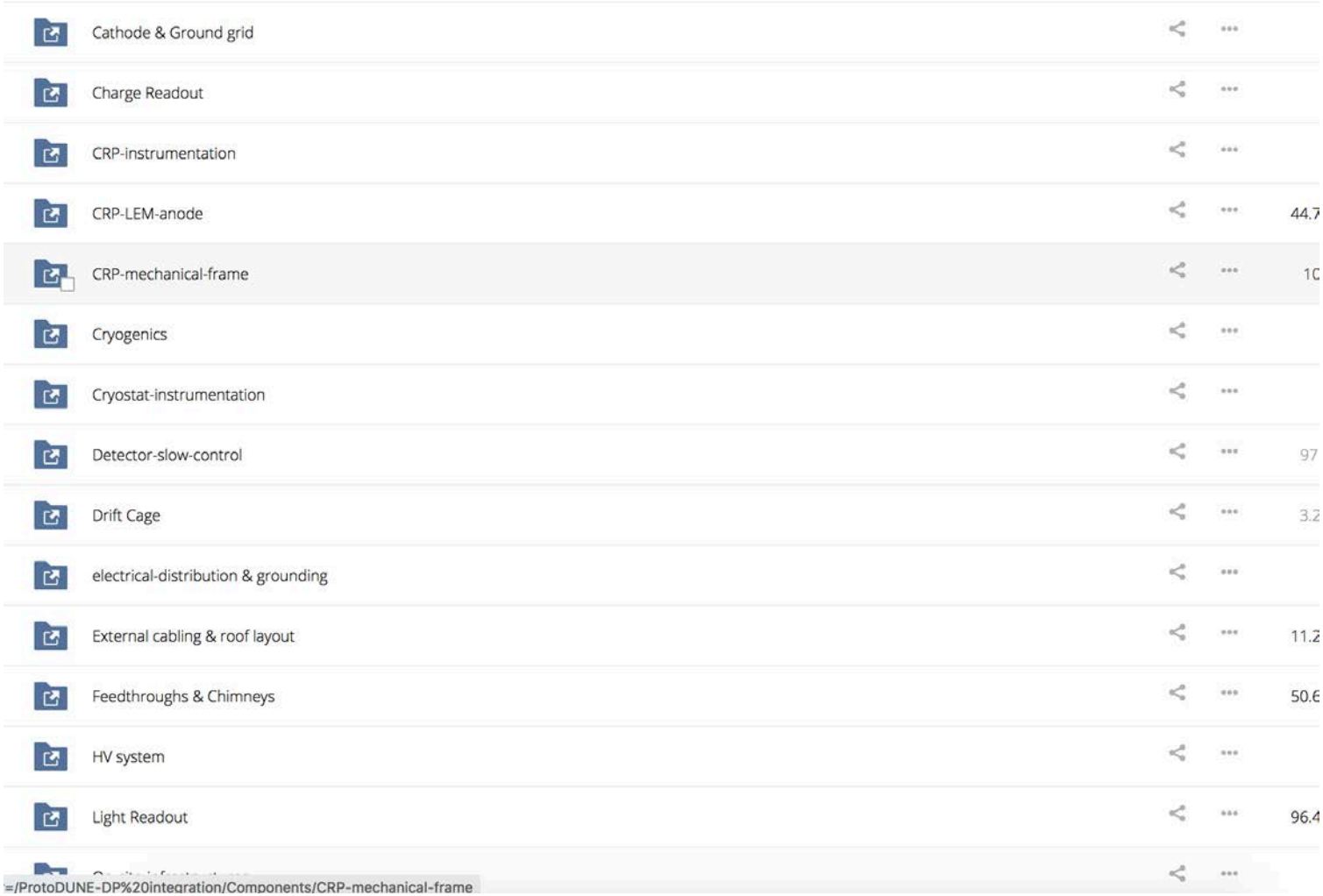
Examples:

- **CRP_INST: Various slow control => 4 elements**
- **FC_SPFT: Field cage suspension FT=> 12 elements**
- **HV systems (LEM, PMTs)**

Document and information sharing organisation

Sharing of information

https://cernbox.cern.ch/index.php/s/54UVObV5xXEZrp5



Sharing of information

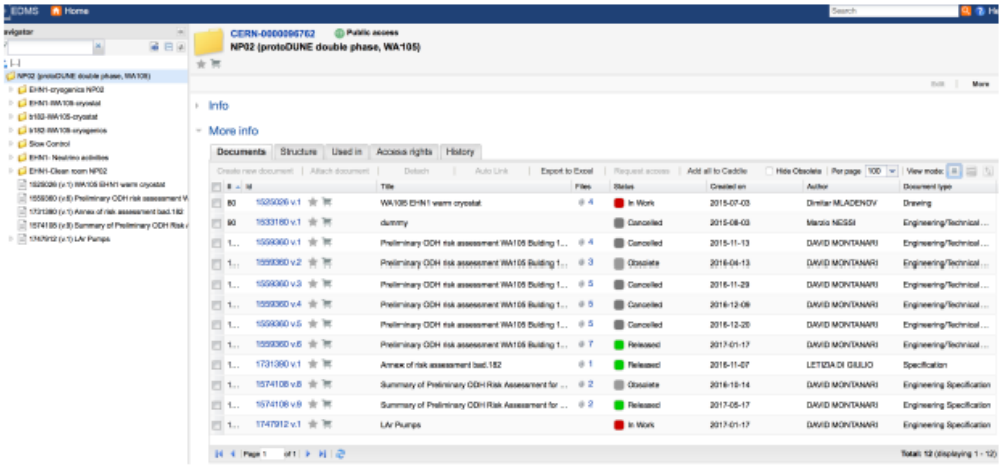
all topics have folders for

- final production drawings (including gerber files for electronics (e.g FE electronics, PMT bases etc..)
- photos
- other drawings or specifications (illustrations, calibration data when applicable, various specifications,…)

CERNbox is very easy to use, we made the effort to organise as clearly as possible the folders, please regularly upload all relevant information (for obvious reasons).

EDMS

https://edms.cern.ch/ui/#!master/navigator/project?P:1263812208:1263812208:subDocs



More for document sharing with HSE

Summary

- Since April start of the phase of tendering, procurements and assembly for CRP, LEM, Anodes, Drift Cage.

- Several steps to follow like Safety validation are mandatory and should be well included.

- Many components should be worked out in more details including finalising designs => lack of engineering manpower

- We are identifying the tasks which will impact the most the schedule:
  The SGFT chimneys are one example of items on critical path.

- In the next Integration meetings: status report from the groups to get the information to update the tasks, human resources and schedule for each item

=> Expect a revised detailed schedule in the coming weeks

Huge and exciting work ahead of us => expect clear contributions from all the collaboration.

Please take the initiative to provide manpower at the different steps of the integration, installation.

In the coming meetings we will provide more details on the exact manpower needed.