Detector Requirements for IP Campus

Karsten Buesser

Mini-Workshop on ILC Infrastructure and CFS for Physics and Detectors
15.03.2016

E-JADE is a Marie Sklodowska-Curie Research
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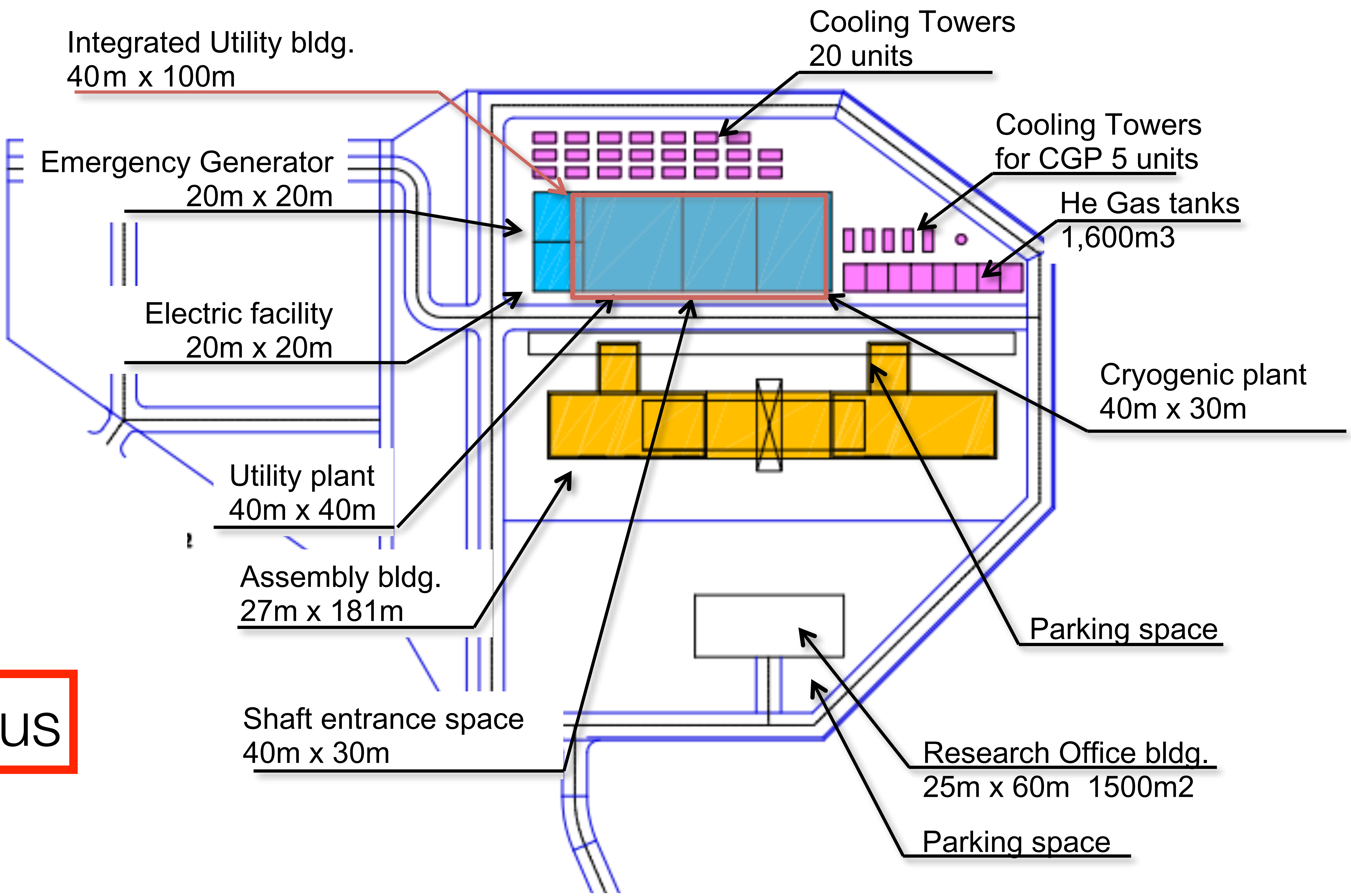
E-JADE

IP Campus Planning Status

Slide from Yoshinobu Nishimoto

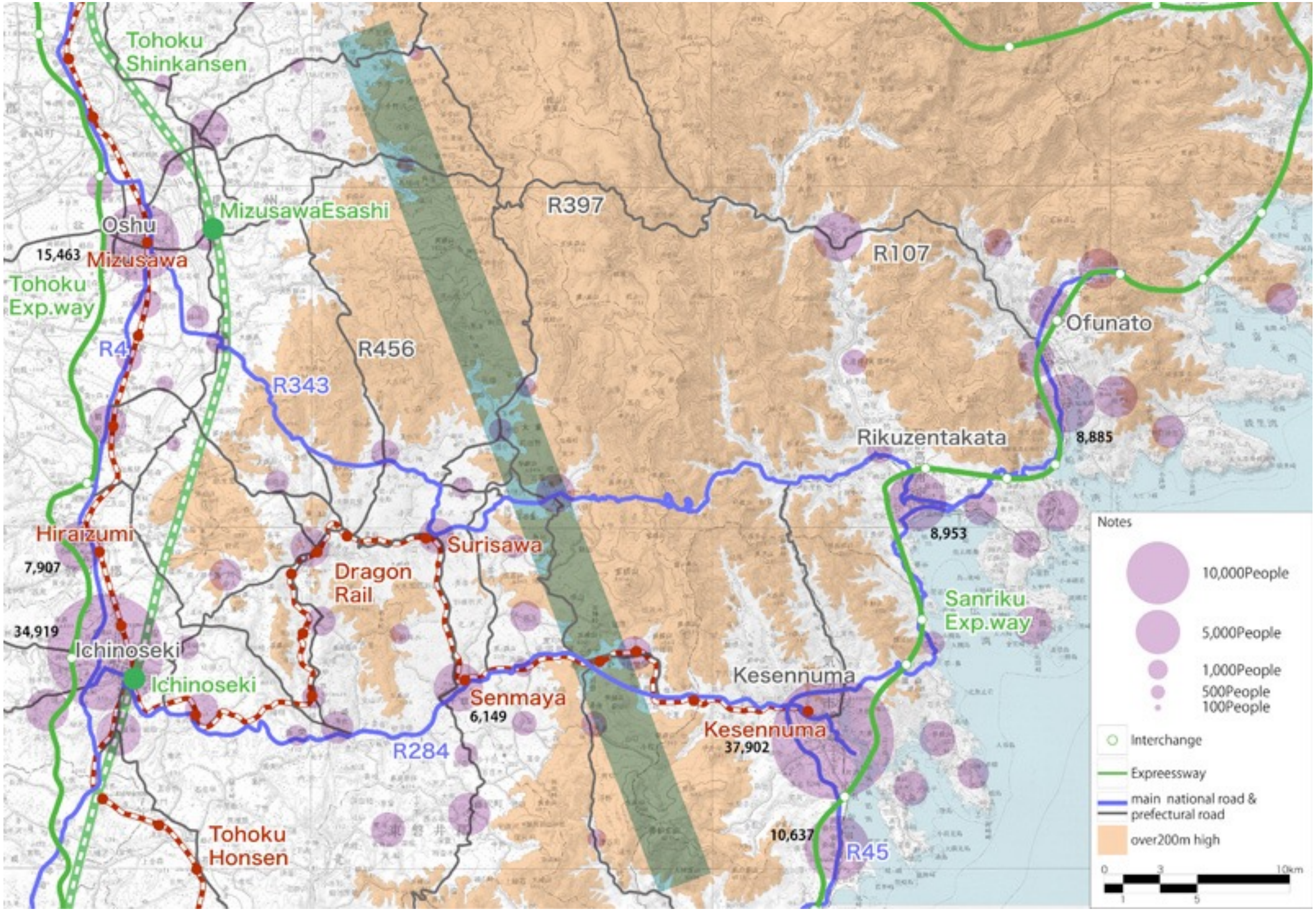
Surface ground Buildings and facilities



IP Campus

KITAKAMI Site: Transportation

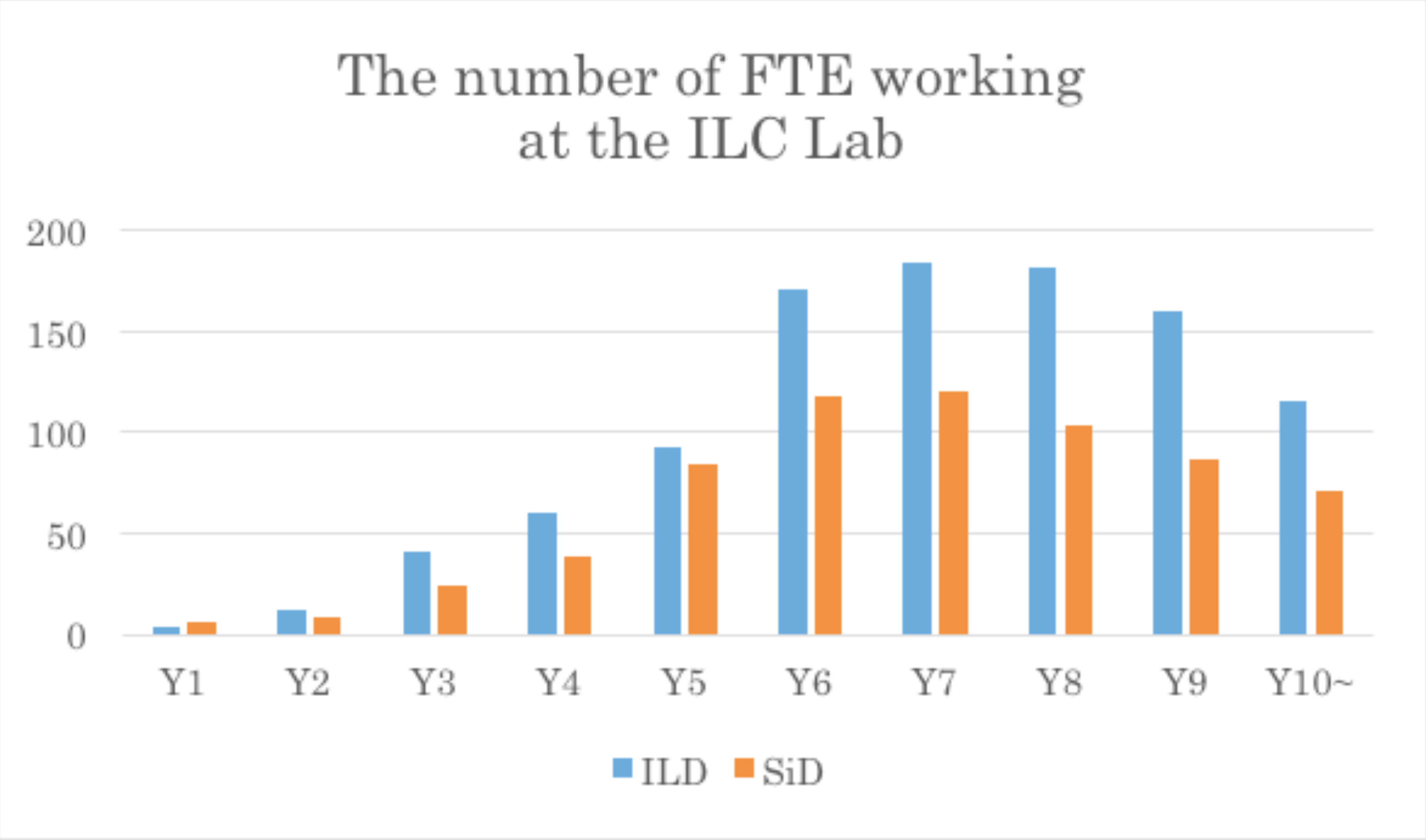
Slide from Tokiko Onuki

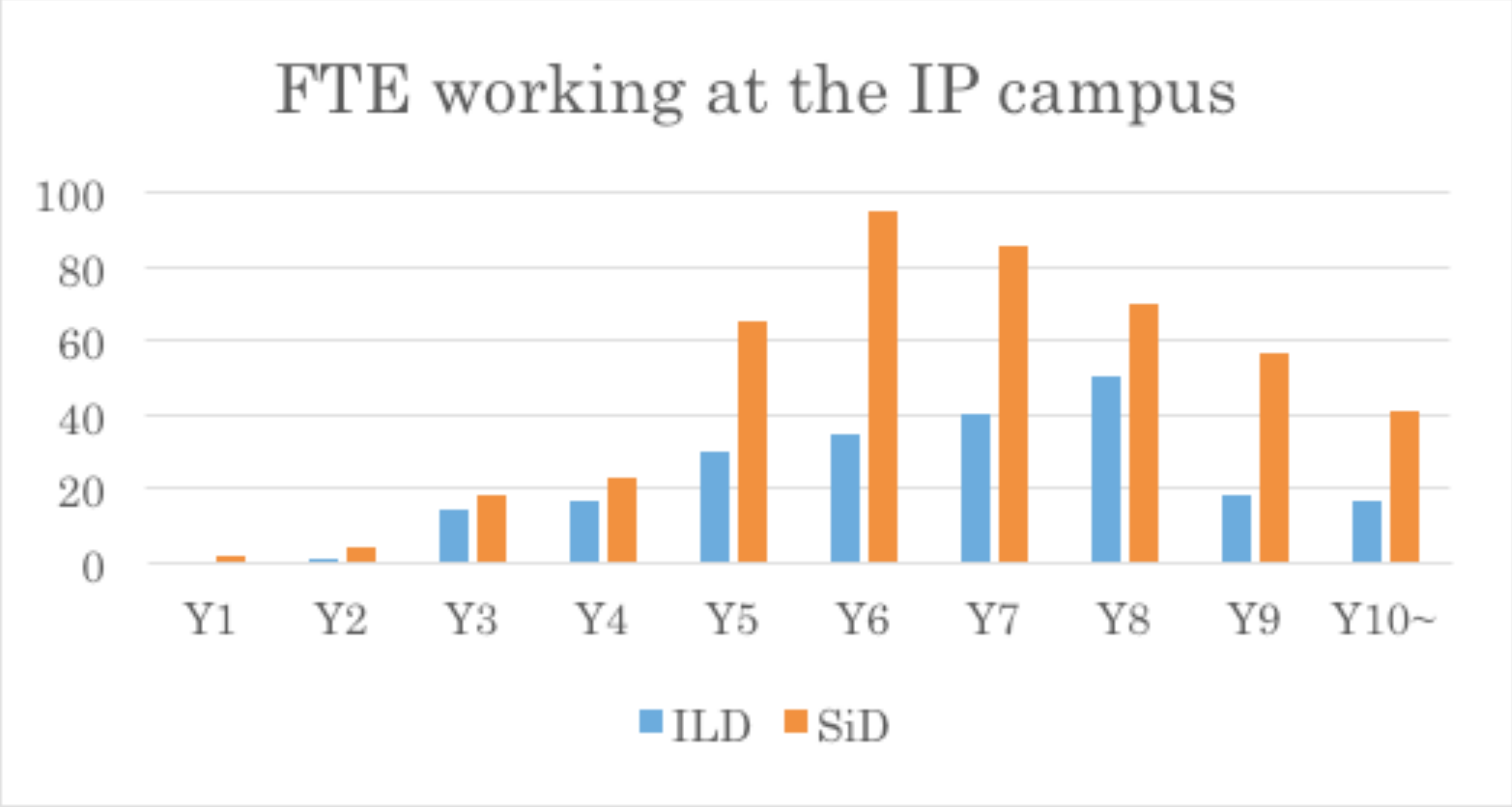


Manpower at IP Campus

- ILD and SiD have estimated number of FTEs working at the IP Campus (under and above ground)
- In peak detector installation times, we expect ~150 FTE at the IP campus
- During operation years, we still expect 50-60 FTE
- ~300 FTE at Central Lab Campus in peak times

- How reliable are these numbers?
- They clearly depend on the assumptions for the detector assembly models





ILD Assembly
(selected examples)

AHCAL Assembly

Kitakami Side

or anywhere in any detector

HELMHOLTZ ASSOCIATION

Slide from Karsten Gadow

DESY

AHCAL Assembly

solution: all needed AHCAL parts fit into here

the container fits to standard transport systems

as ships, railways, trucks and through tunnels…..

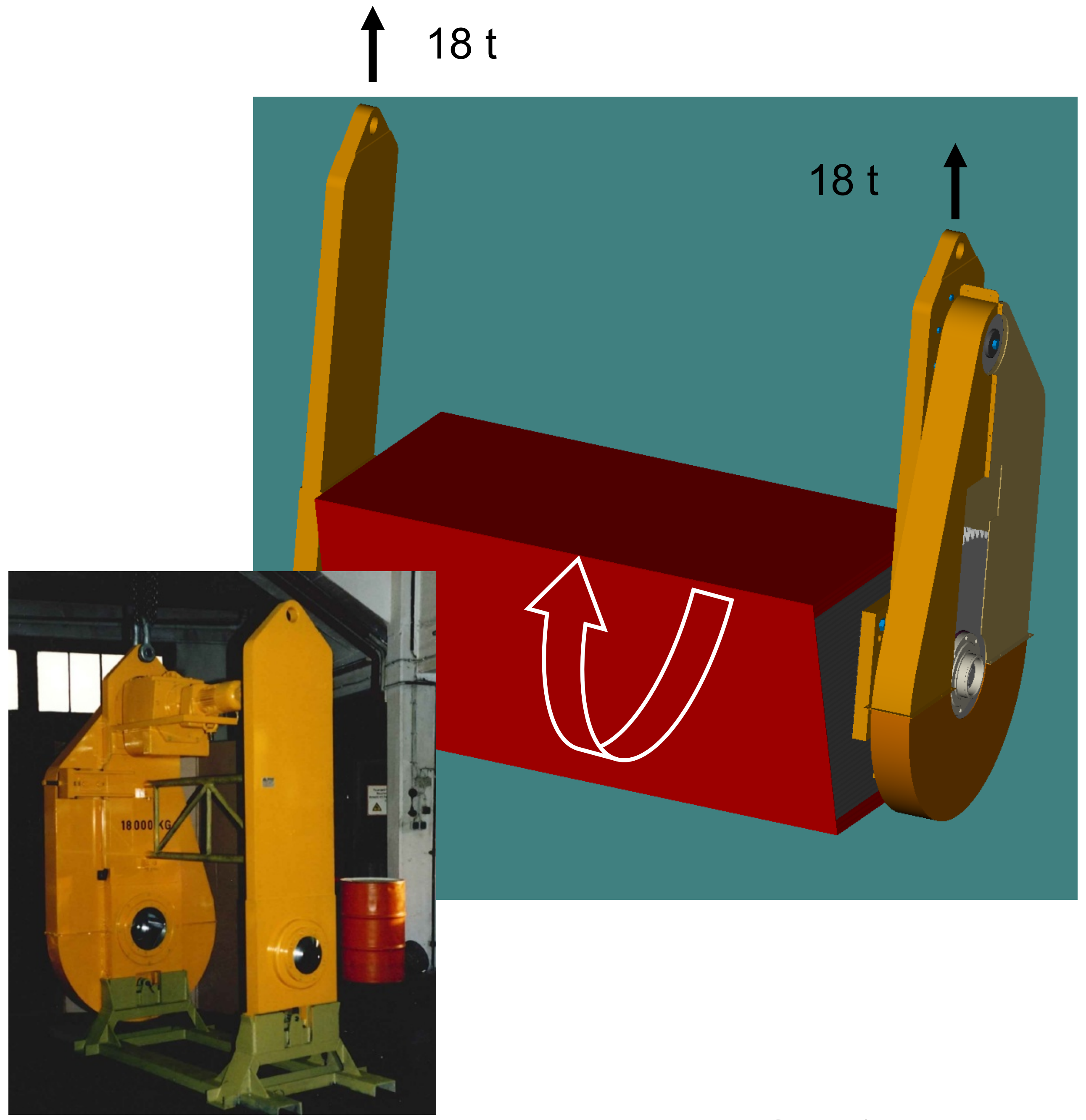
AUSSENMASSE		
Länge	mm	6058
	ft	19' 10 ½"
Breite	mm	2438
	ft	8'
Höhe	mm	2591
	ft	8' 6"

GEWICHT		
Tara	kg	2700
	pd	5950
Max. Zuladung	kg	27780
	pd	61250
Max. Bruttogewicht	kg	30480
	pd	67200

DESY

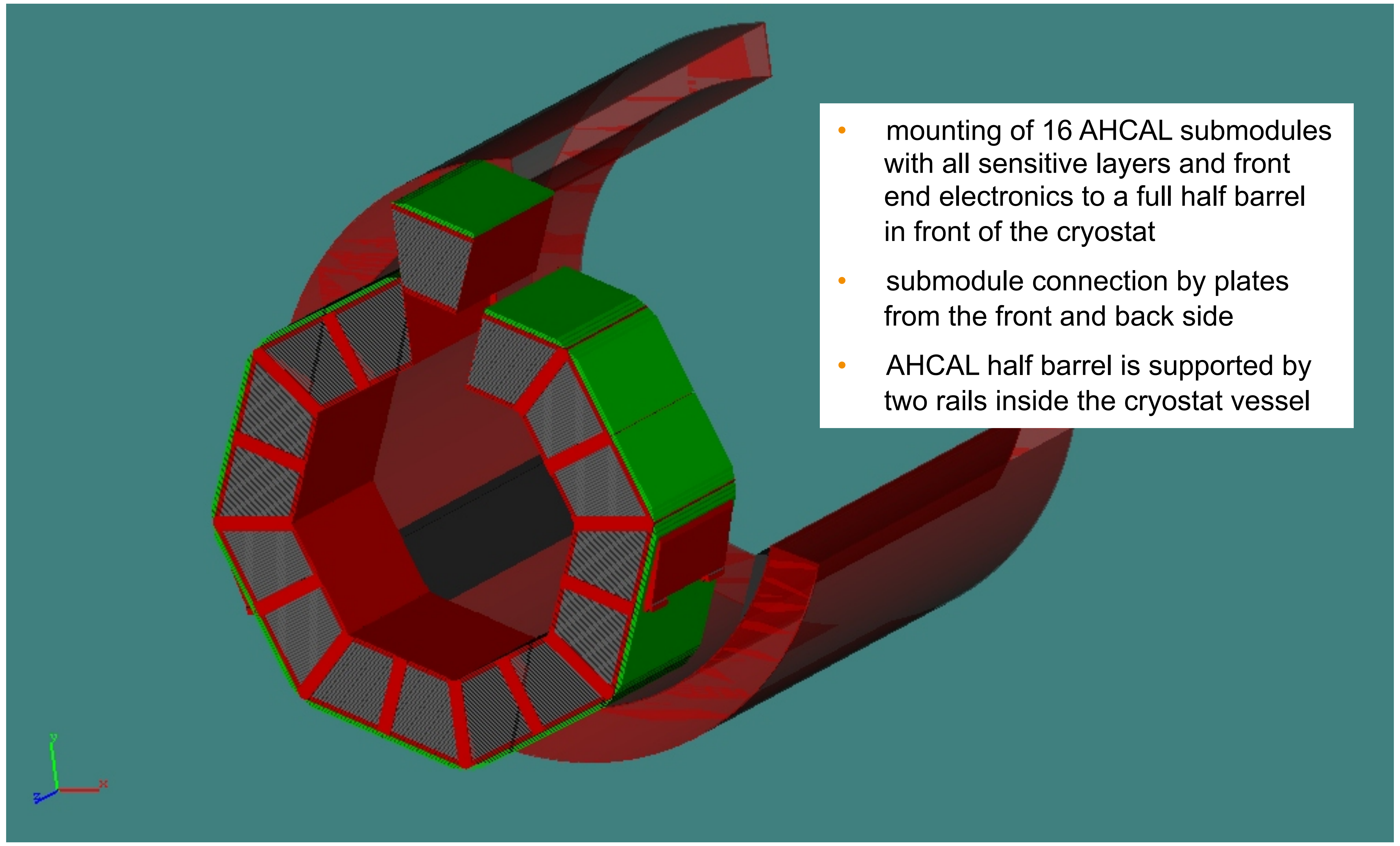
Slide from Karsten Gadow

AHCAL barrel integration tools



- lifting and turning tool for AHCAL barrel absorber submodules available
  - 2 x 18 t capacity
  - operation with 2 hooks (z angle adjustment)
  - precise motor controlled turning
  - design for adaptation for sub-modules with and without sensitive layers started
- mounting, support and insertion frame
  - insertion frame design ready
  - insertion frame support design depends on final yoke size and useable space
- push and pull tool available
  - must be modified to the rail distance and rail shape/size

AHCAL half barrel absorber installation
step 1



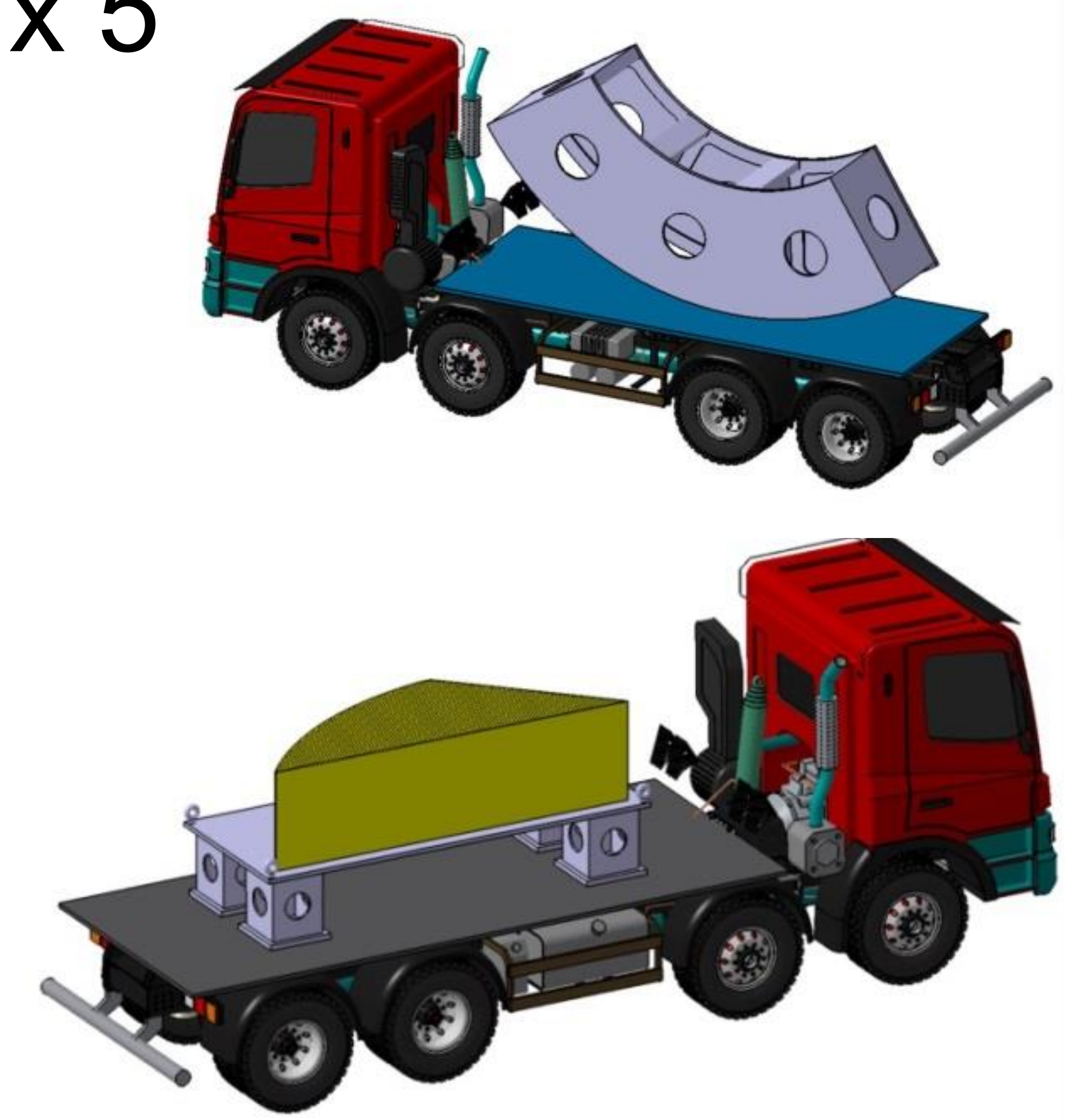
- mounting of 16 AHCAL submodules with all sensitive layers and front end electronics to a full half barrel in front of the cryostat
- submodule connection by plates from the front and back side
- AHCAL half barrel is supported by two rails inside the cryostat vessel

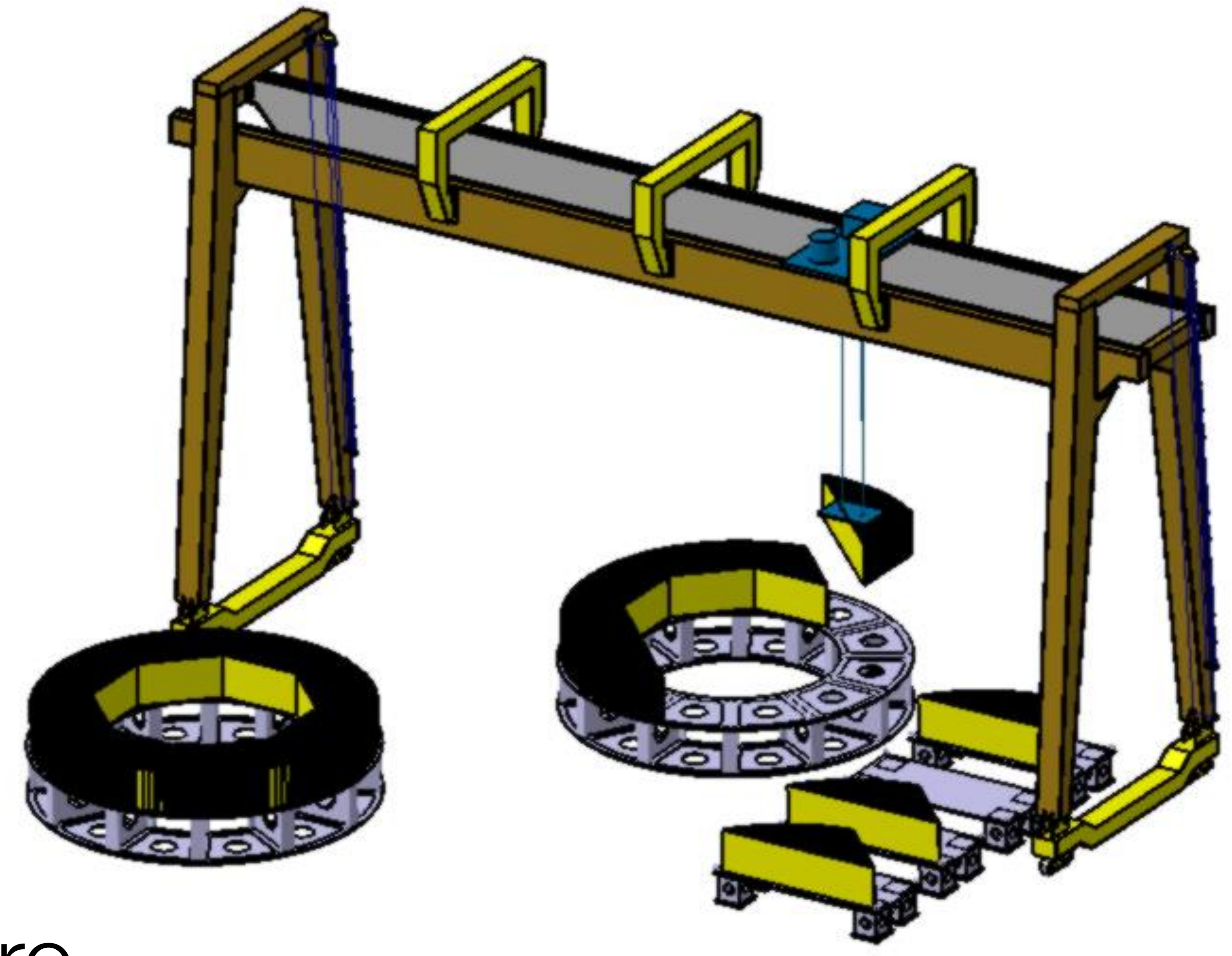
Slides from Karsten Gadow

Wheel Building in **Assembly Hall** : 8 modules x 5

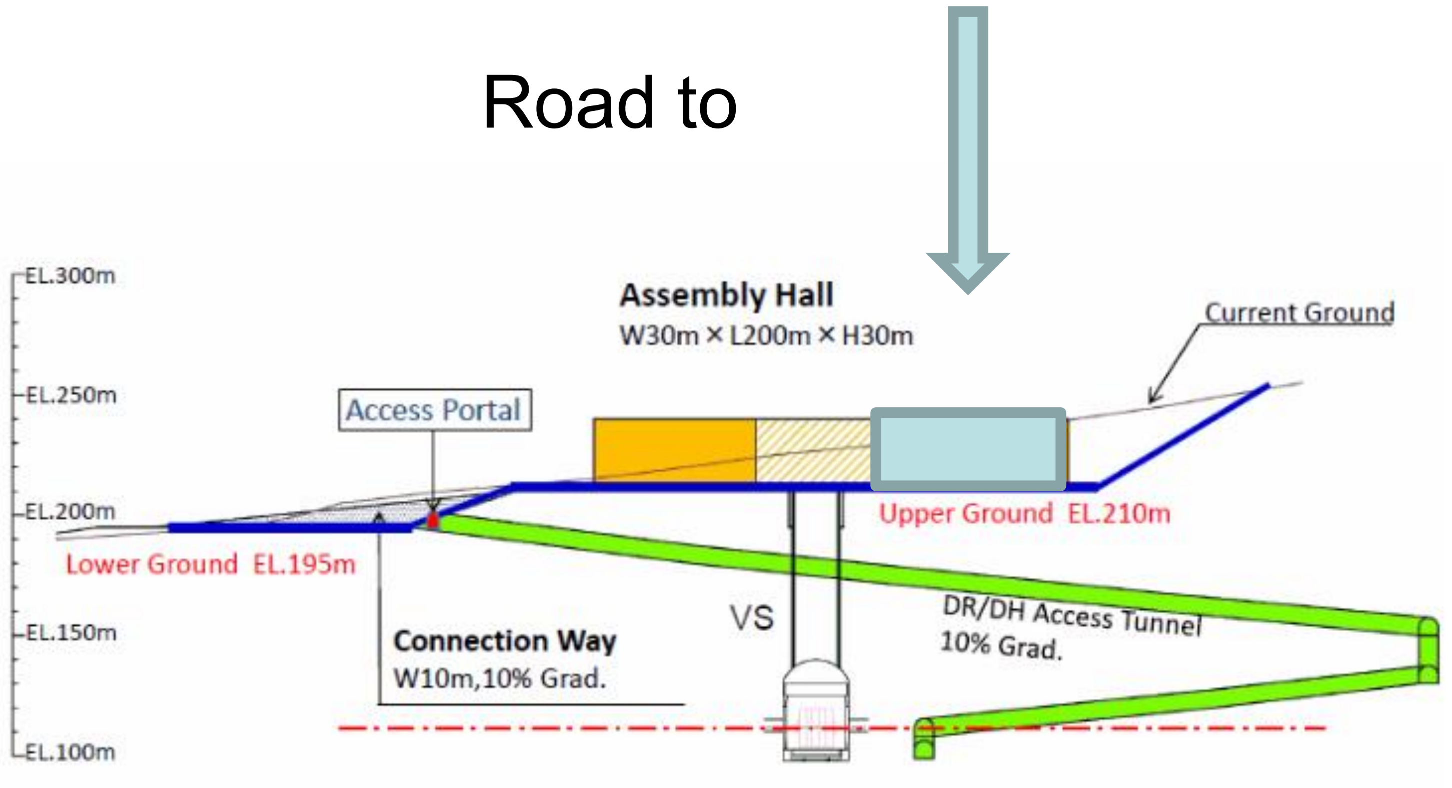
Transport to Assembly Hall with normal truck - ILD area

- **Step 1** : Wheel structure transport (8 travels) & assembly
- **Step 2** : Modules transport 40 travels with 11 t
- **Step 3 :** Modules assembly on the wheel structure with 100 t crane
  - 8 modules in position on specific tool & screwing/welding





Road to



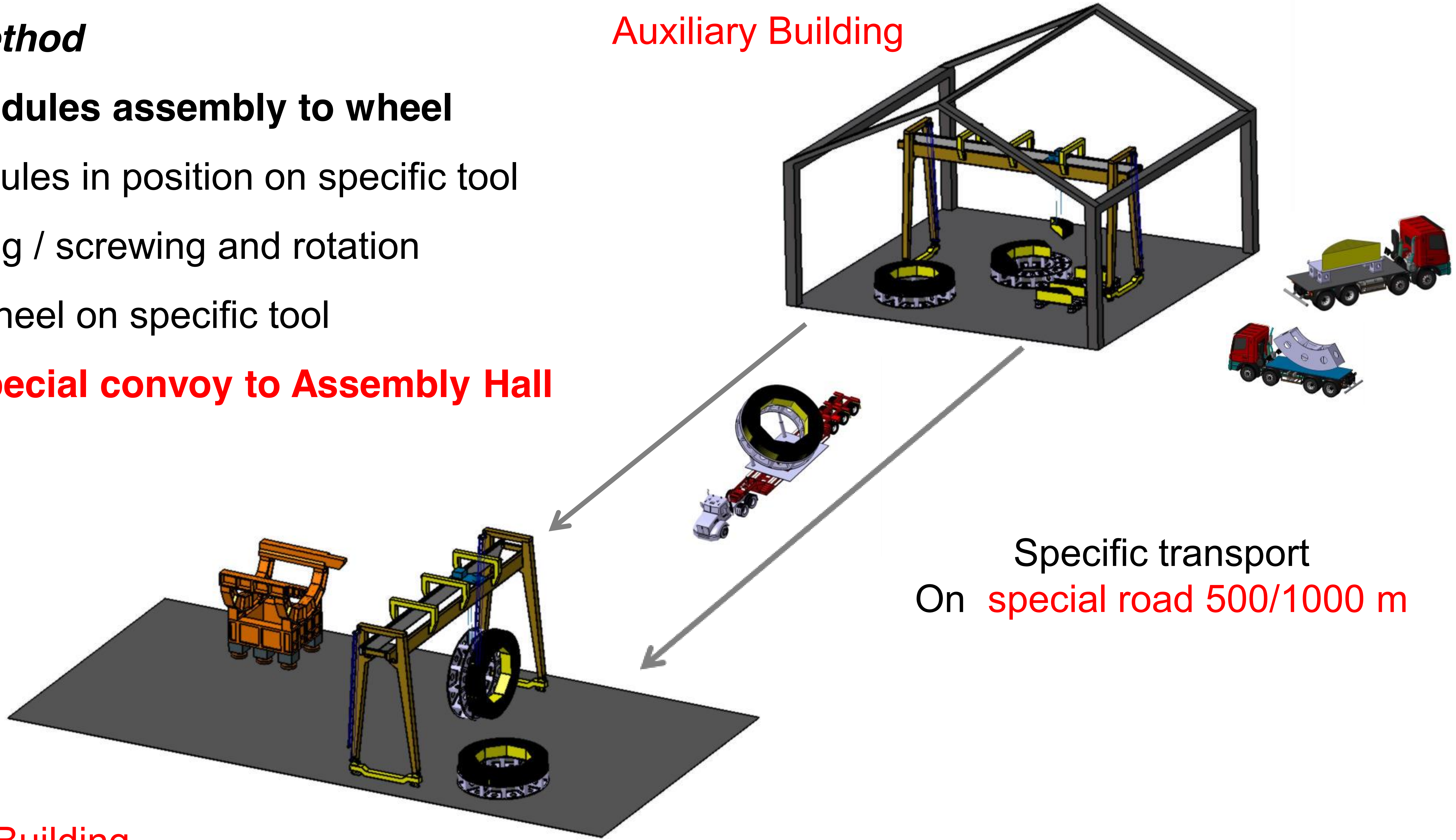
Longitudinal section

Slide from J.C. Ianigro

Wheel assembly in Auxiliary building : s

Building Method

- **Step 1 : Modules assembly to wheel**
  - 8 modules in position on specific tool
  - welding / screwing and rotation
- **Step 2 :** Wheel on specific tool
- **Step 3** : **Special convoy to Assembly Hall**

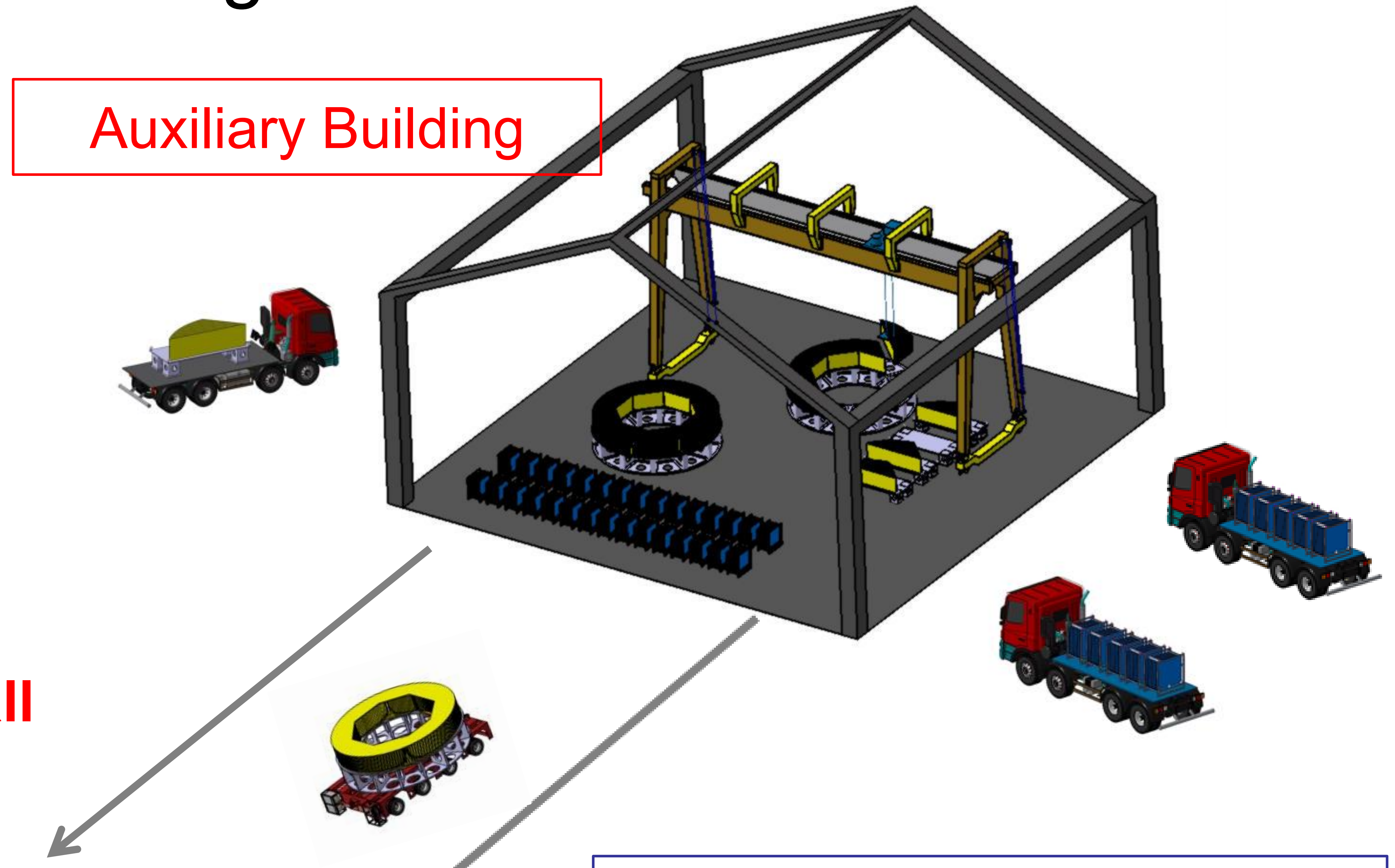


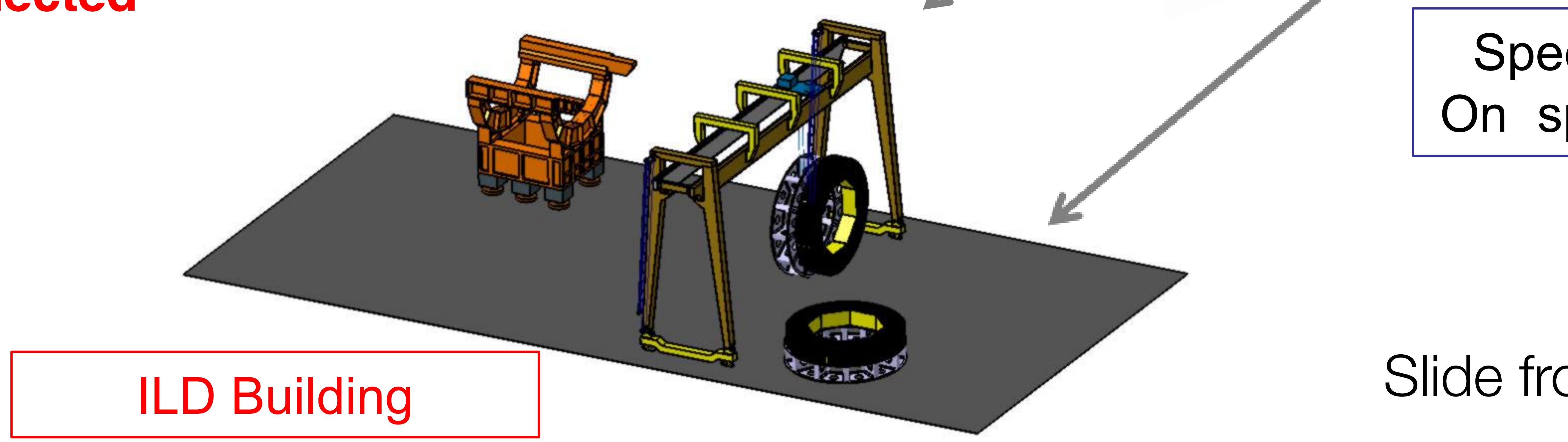
Slide from J.C. Ianigro

Wheel assembly in Auxiliary building : 8 modules => 5 wheels

Building Method

- **Step 1 : Modules assembly to wheel**
  - 8 modules in position on specific tool
  - welding / screwing and rotation
- **Step 2 :** Wheel on specific tool
- **Step 3** : GRPC insertion and connected
- **Step 4** : **Special convoy to Assembly Hall with GRPC inside wheels – ready to be connected**



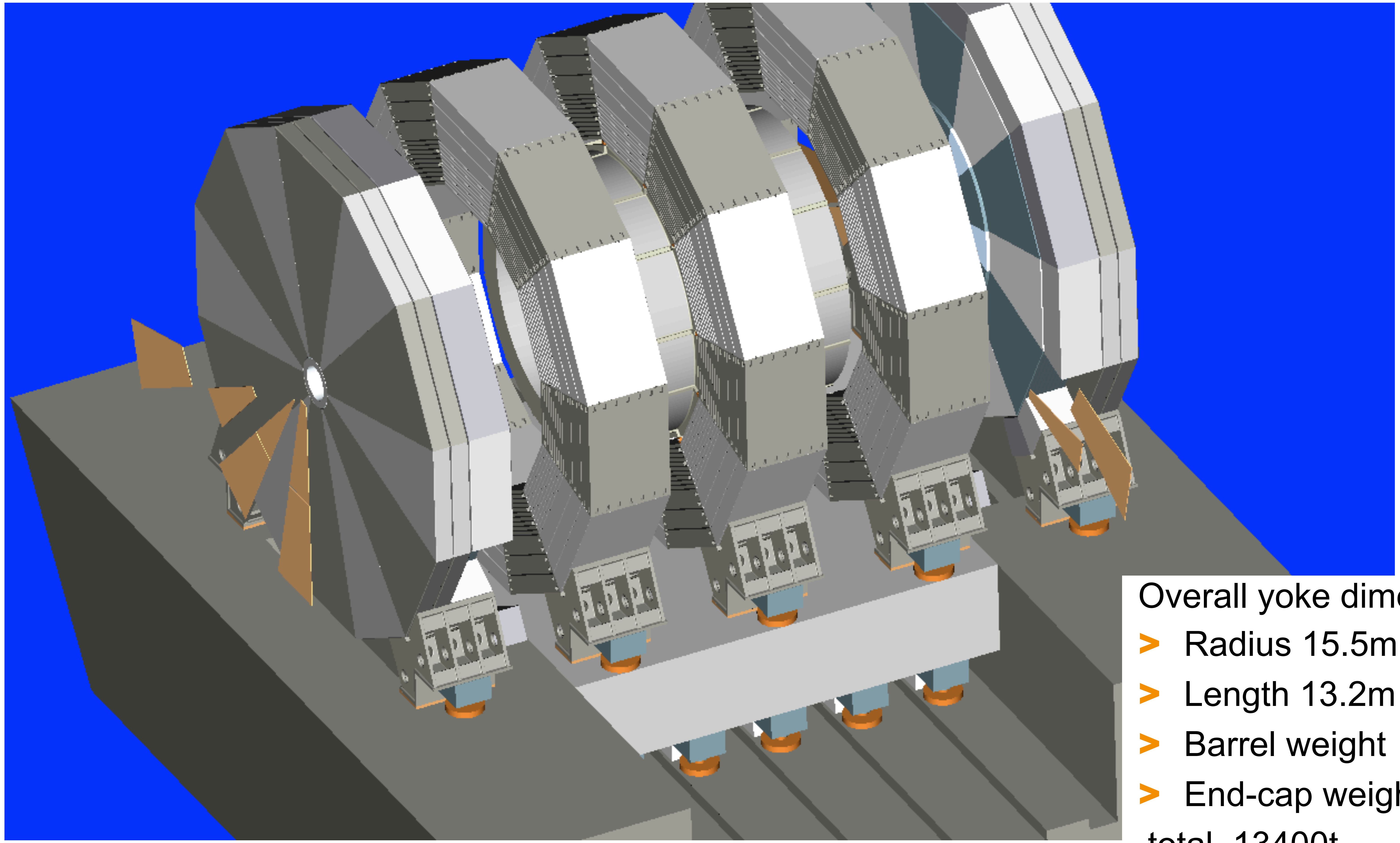


Specific Damper transport
On special road 500/1000 m

Slide from J.C. Ianigro

Heaviest Problem: Iron Yoke

Present Design



Overall yoke dimensions

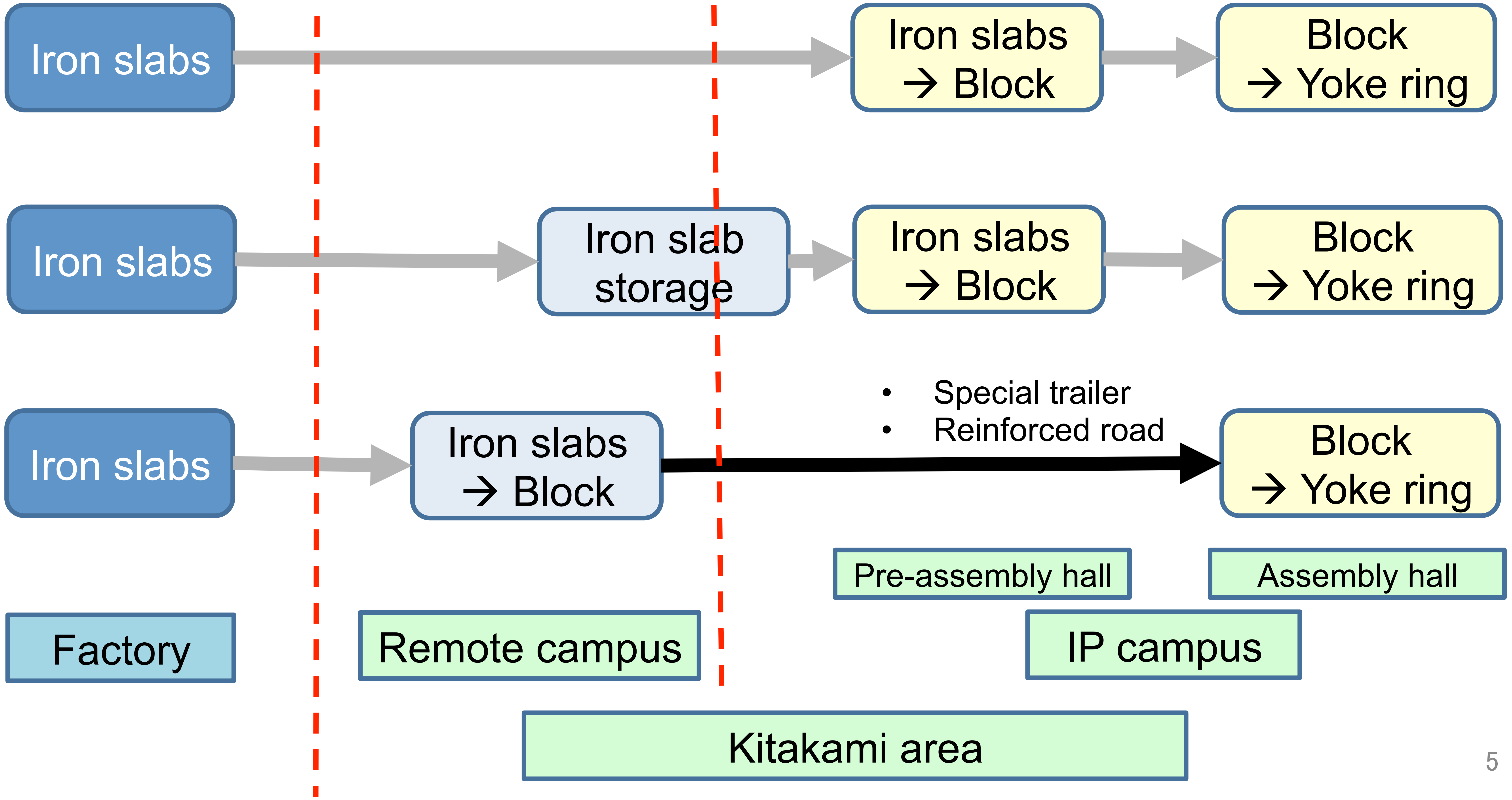
- Radius 15.5m
- Length 13.2m
- Barrel weight 6900t
- End-cap weight 6500t

total 13400t

Slide from Uwe Schneekloth

Assembly scenario

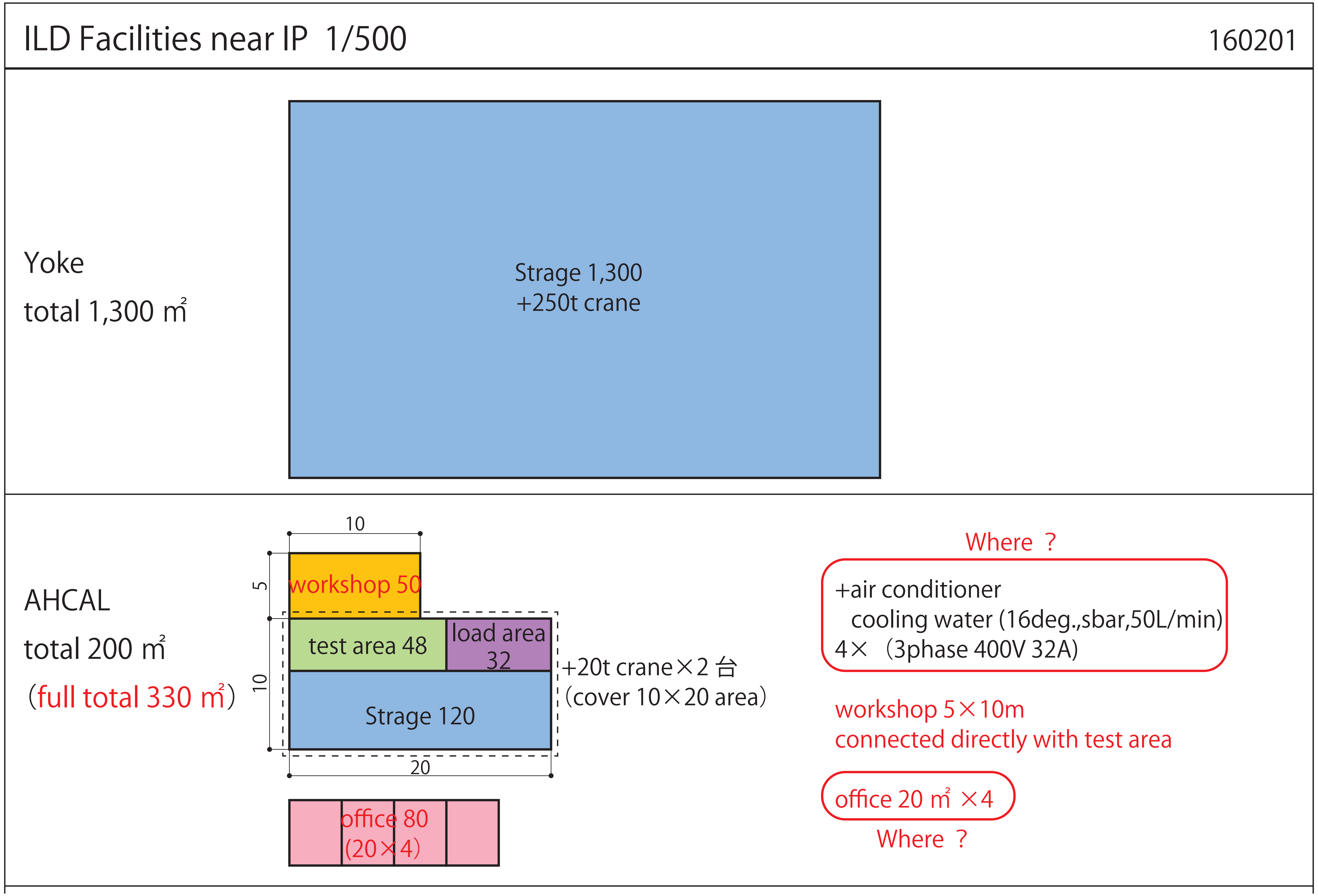
- There are three options



Slide from Uwe Schneekloth

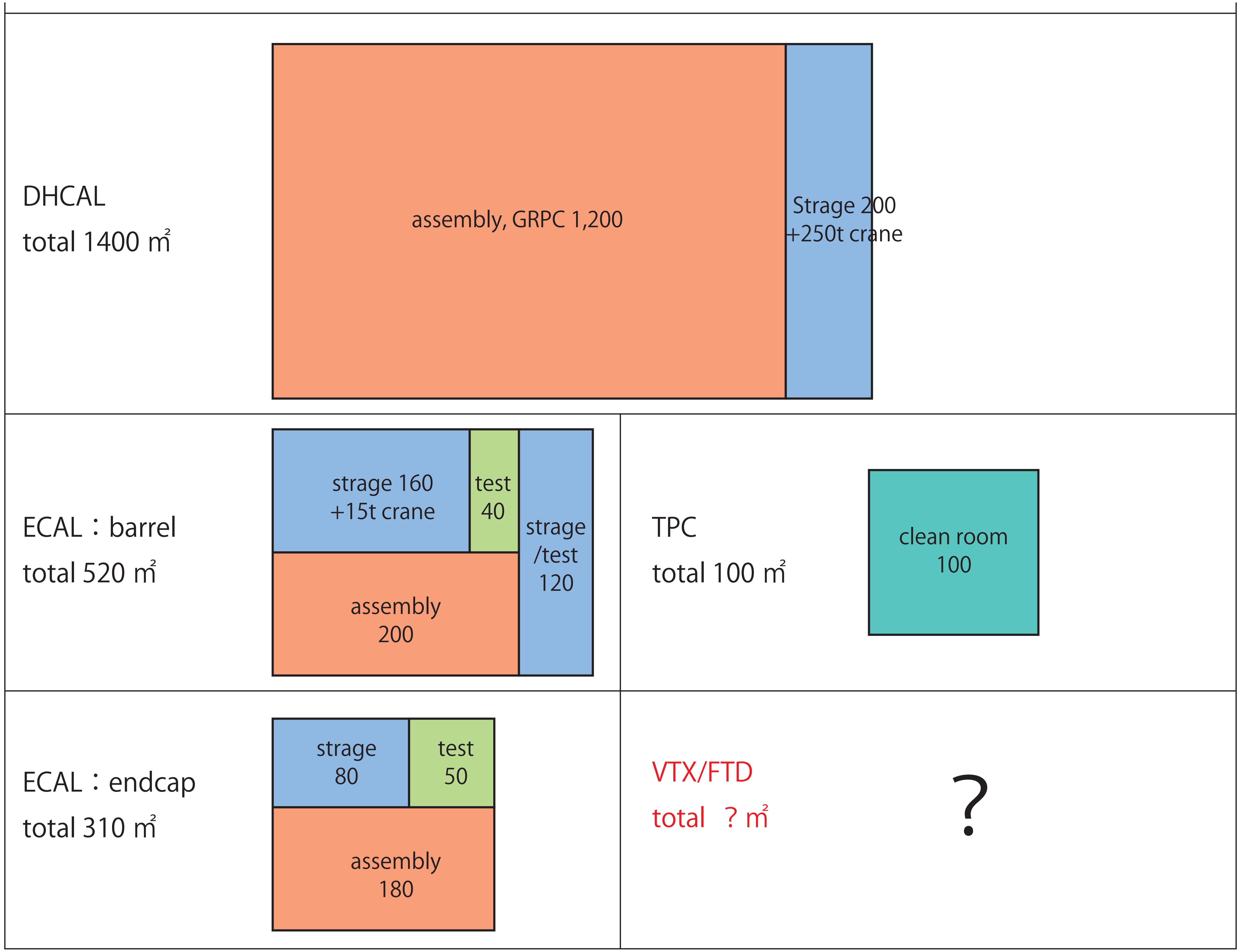
ILD Subdetector Requirements

- Tomo and Tokiko have tried to assemble sub detector space requirements at IP
- We know requirements for some sub detectors quite precisely, but for others not at all…



T. Sanuki, T. Onuki

ILD Subdetector Requirements

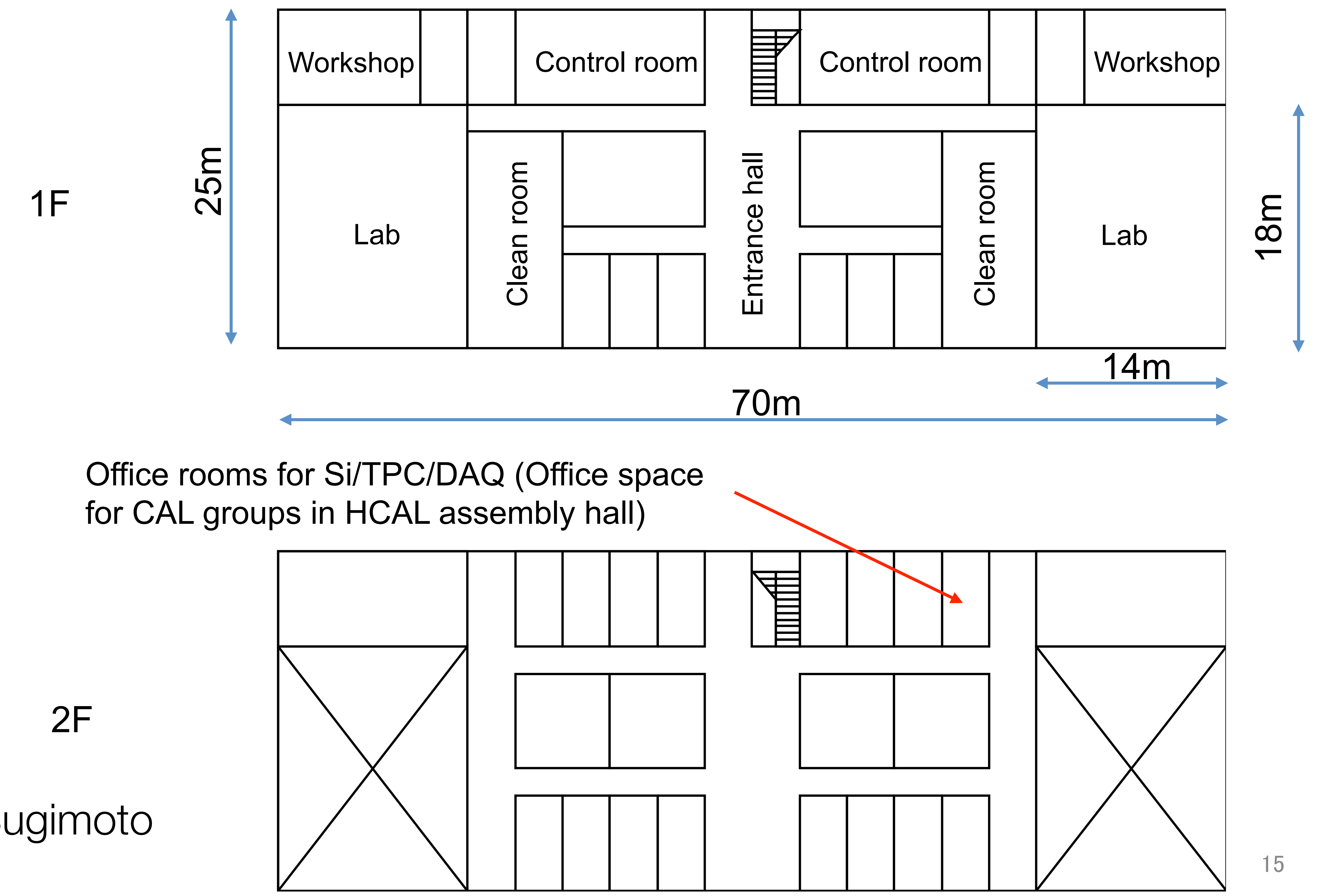


T. Sanuki, T. Onuki

Research Office Building at IP Campus (proposal)

- Requirements for Research Office Building:
  - Control rooms of experiments
  - Meeting rooms
  - Clean rooms (TPC, SI)
  - Office Space
  - Lab space with crane and gas equipment/ventilation

A possible design of ROB on IP campus

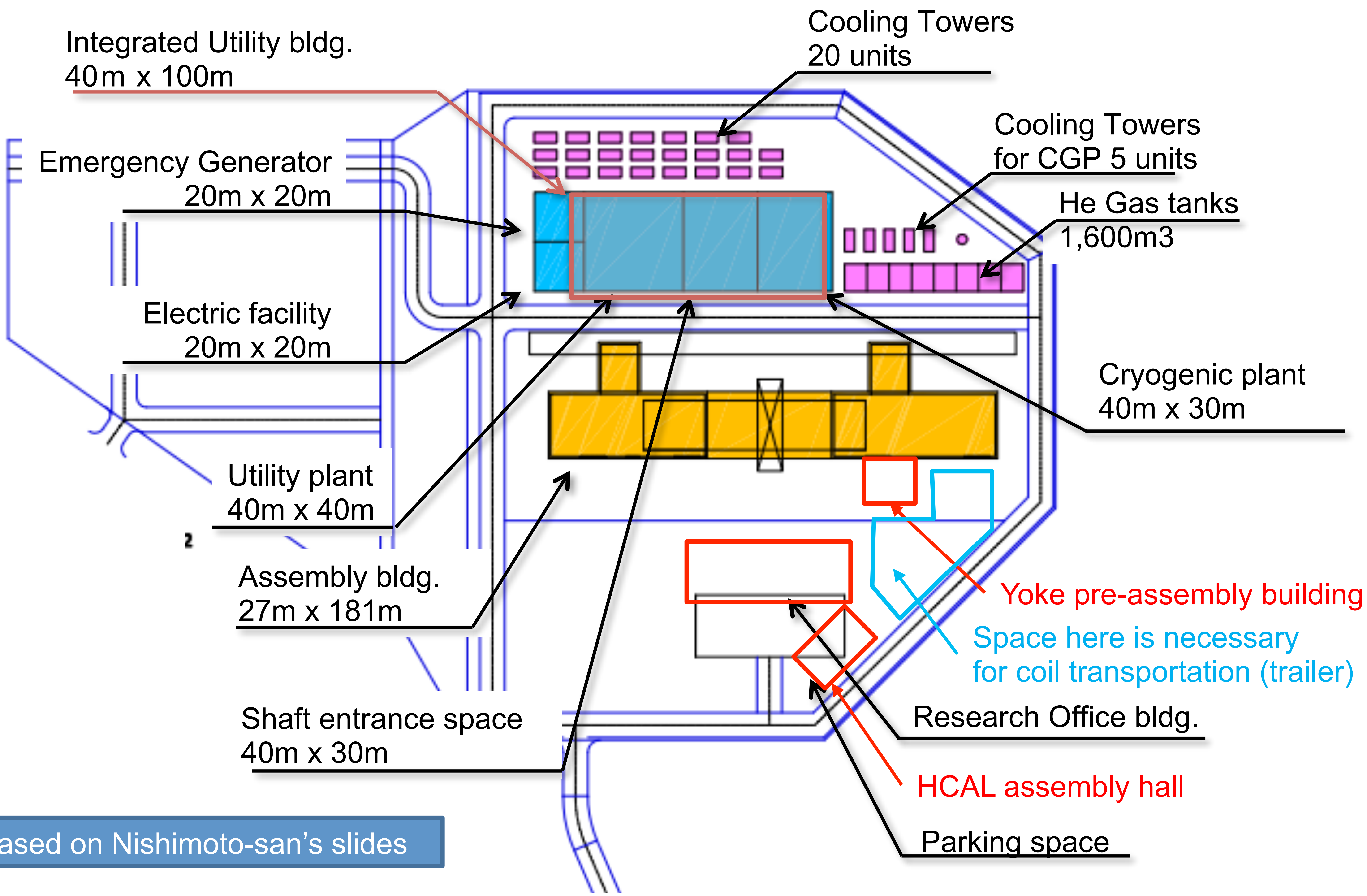


Slide from Yasuhiro Sugimoto

Detector Assembly Facilities at IP Campus (proposal)

- Need pre-assembly space for heavy detector elements
  - HCAL, Yoke
- Pre-assembly of yoke elements (welding, crane)
- Assembly of HCAL elements
  - e.g. DHCAL rings (<125t)
- Need to keep transportation routes in mind…

IP campus with 600m^2 HCAL-AH



Based on Nishimoto-san's slides

Slide from Yasuhiro Sugimoto

Assembly Study ILD (Work in Progress)

- Optimisation of ILD assembly is on-going work
- Biggest uncertainty:
  - where and how to build the coil
- Proposal: pre-assembly area for yoke and HCAL elements next to detector assembly hall
- Crane/movement capacities under study
- Could be temporary building

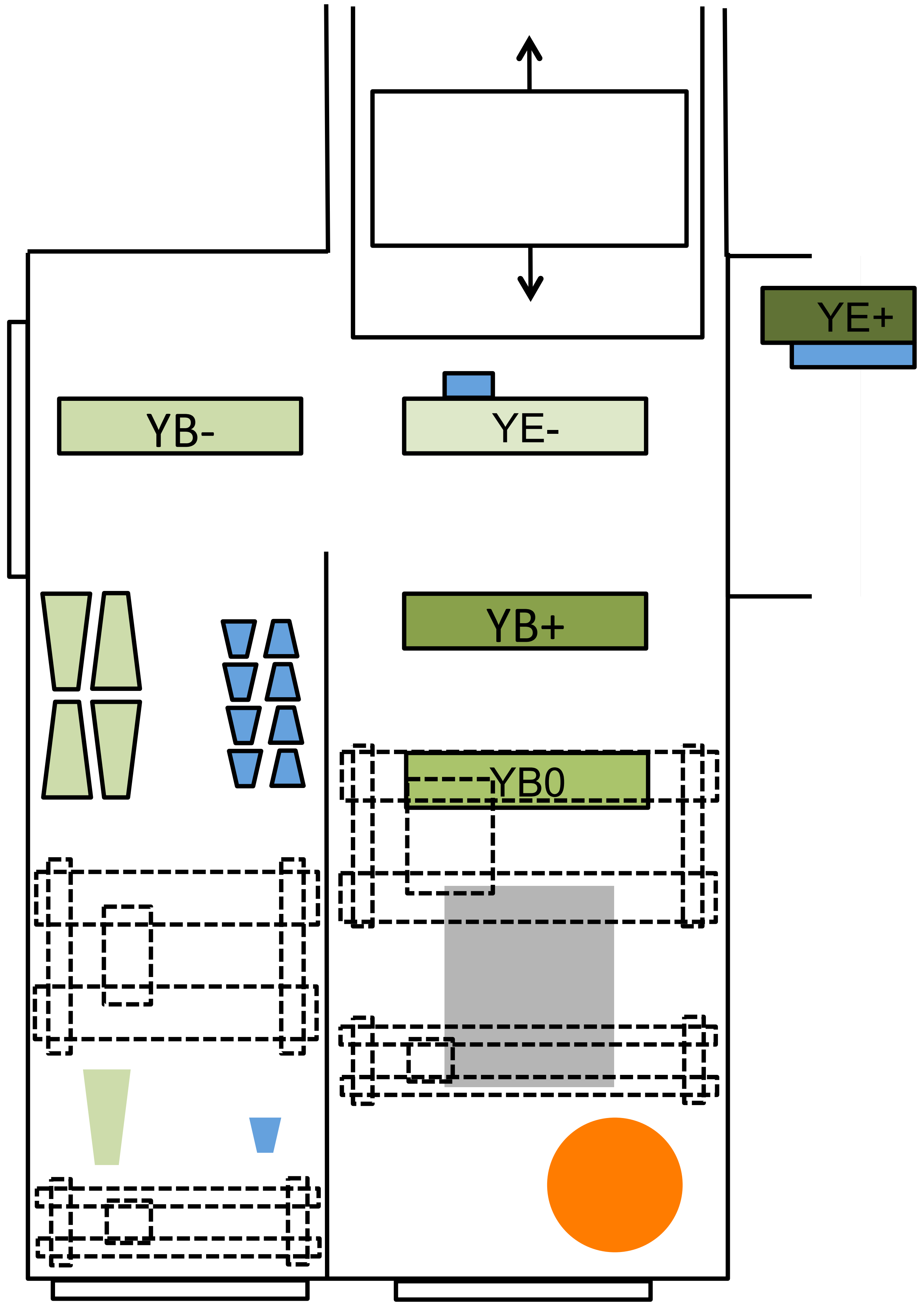
Integration Proposal

> YB-: production + assembly

- One production lane for about 6 months (12 modules)
- In parallel: solenoid assembly
- In parallel: finalisation of muon installation in YE+ and begin muon installation in YB0 (120 days)

> HCAL production for endcaps

- Mounting YE- HCAL
- Start YB- yoke assembly once YE-HCAL is ready or assemble YB- wheel in garage



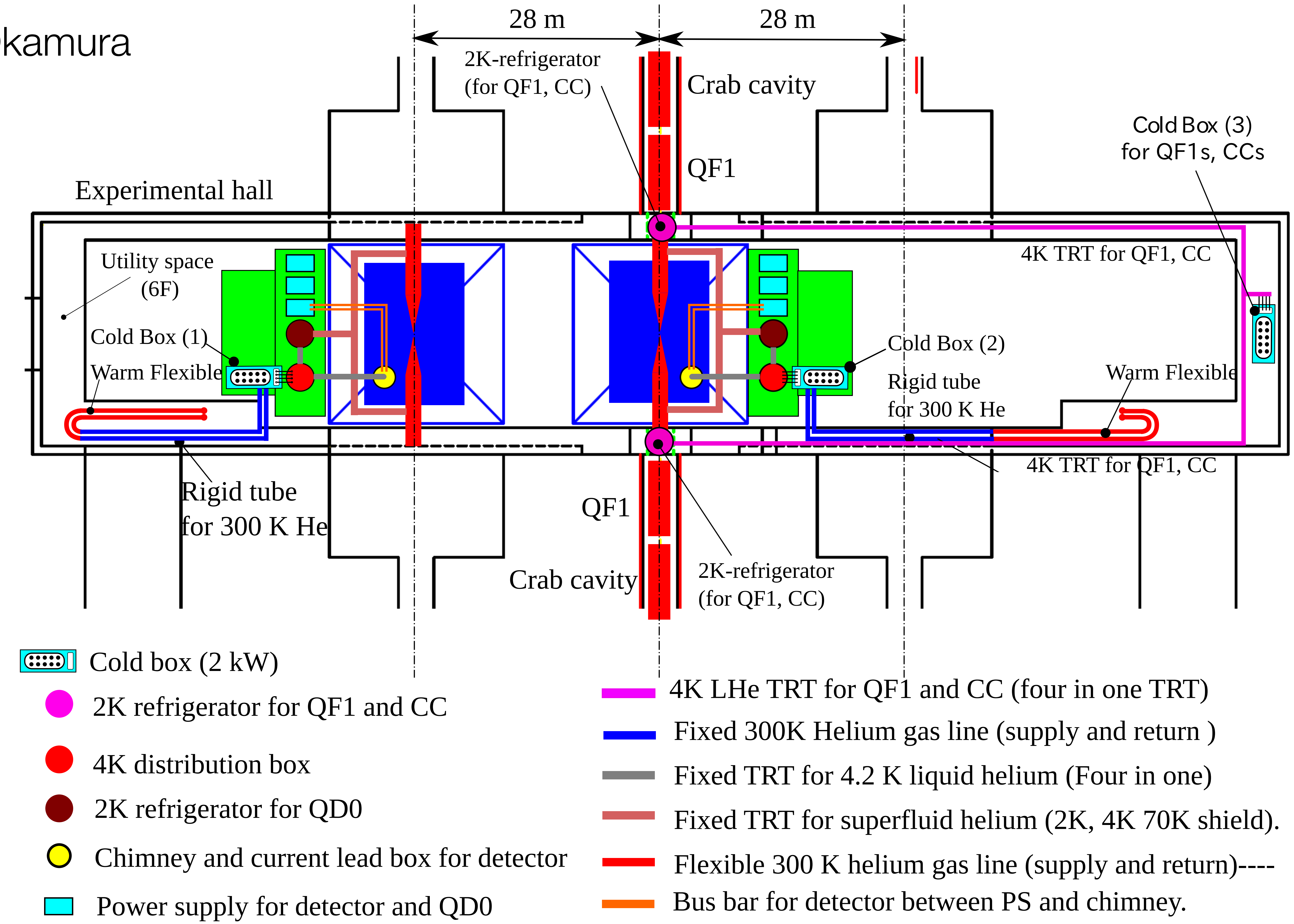
TSS, February 2016

Slide from Thomas Schörner-Sadenius

Detector Infrastructures

Layout example in DH (ILD,SiD,QD0,QF1,CC)

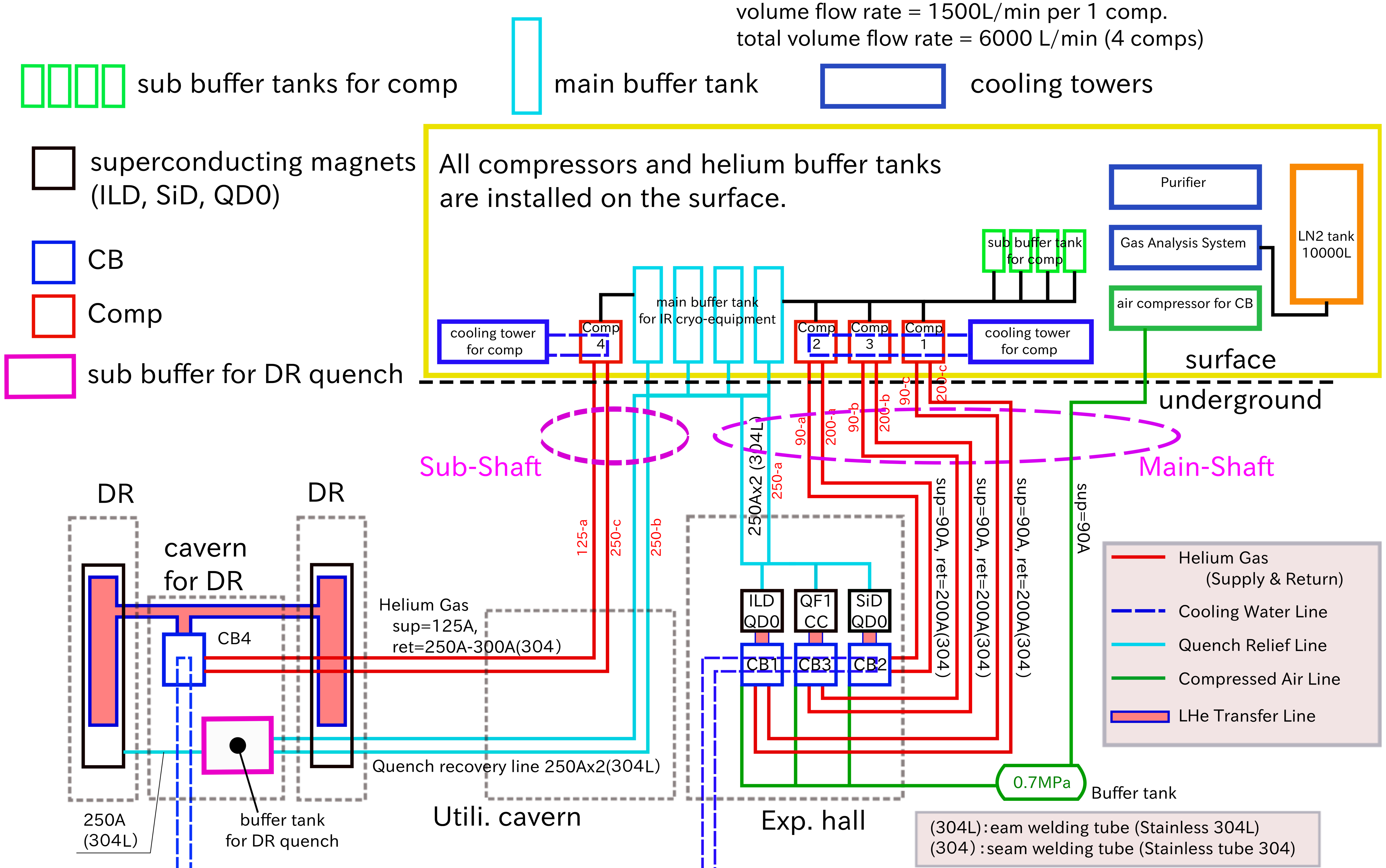
Slide from Takahiro Okamura



Cryo Configuration (ILD,SID,QD0,QF1,CC,DR)

Hybrid A' (All pipes for Helium and cooling water.)

cooling tower for IR compressors including DR.
volume flow rate = 1500L/min per 1 comp.
total volume flow rate = 6000 L/min (4 comps)



cooling water for turbine is supplied from
cooling water system located in the underground
100L/min per one CB.
Inlet temp = 31 deg.

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100L/min per one CB.
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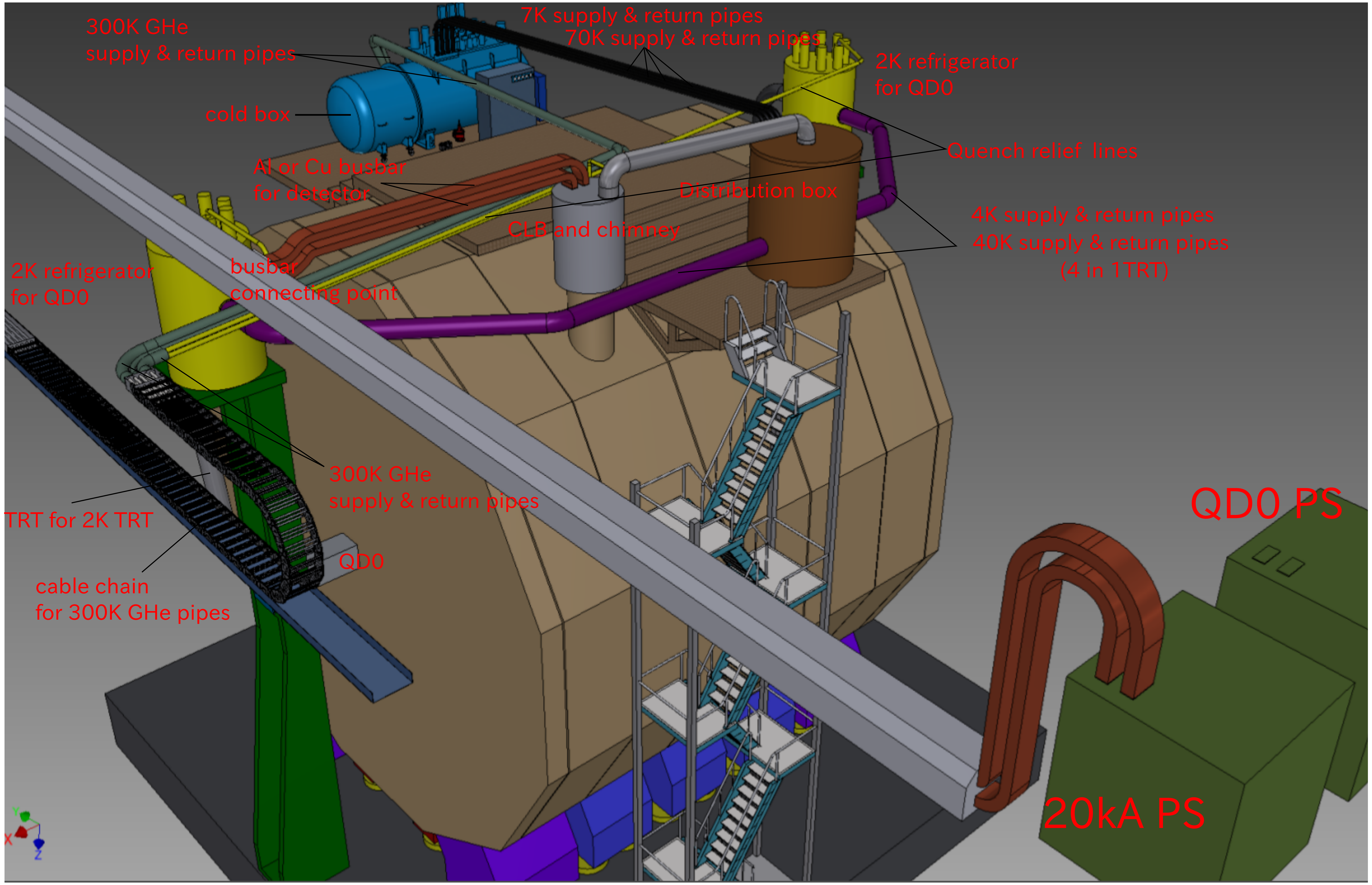
Slide from Takahiro Okamura

Appendix (E) : 3D view

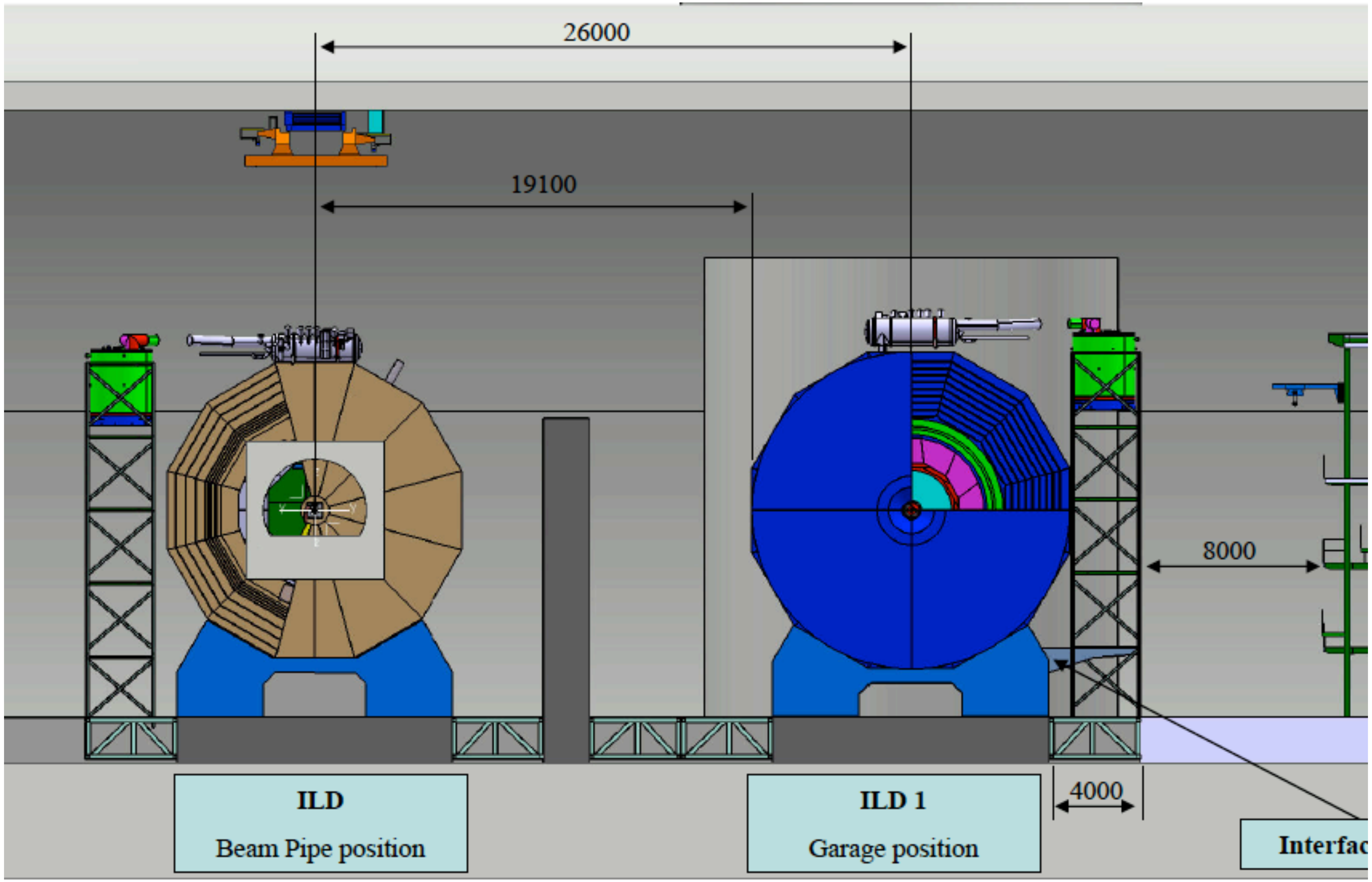
- Cryo equipment planned to be on detector
- Space requirements?
  - crane hook heights
- Vibrations?



Slide from Takahiro Okamura

Garage Position

- Discussed already in 2009:
  - put noisy equipment on trailer/tower next to detector platform
- No engineering design so far



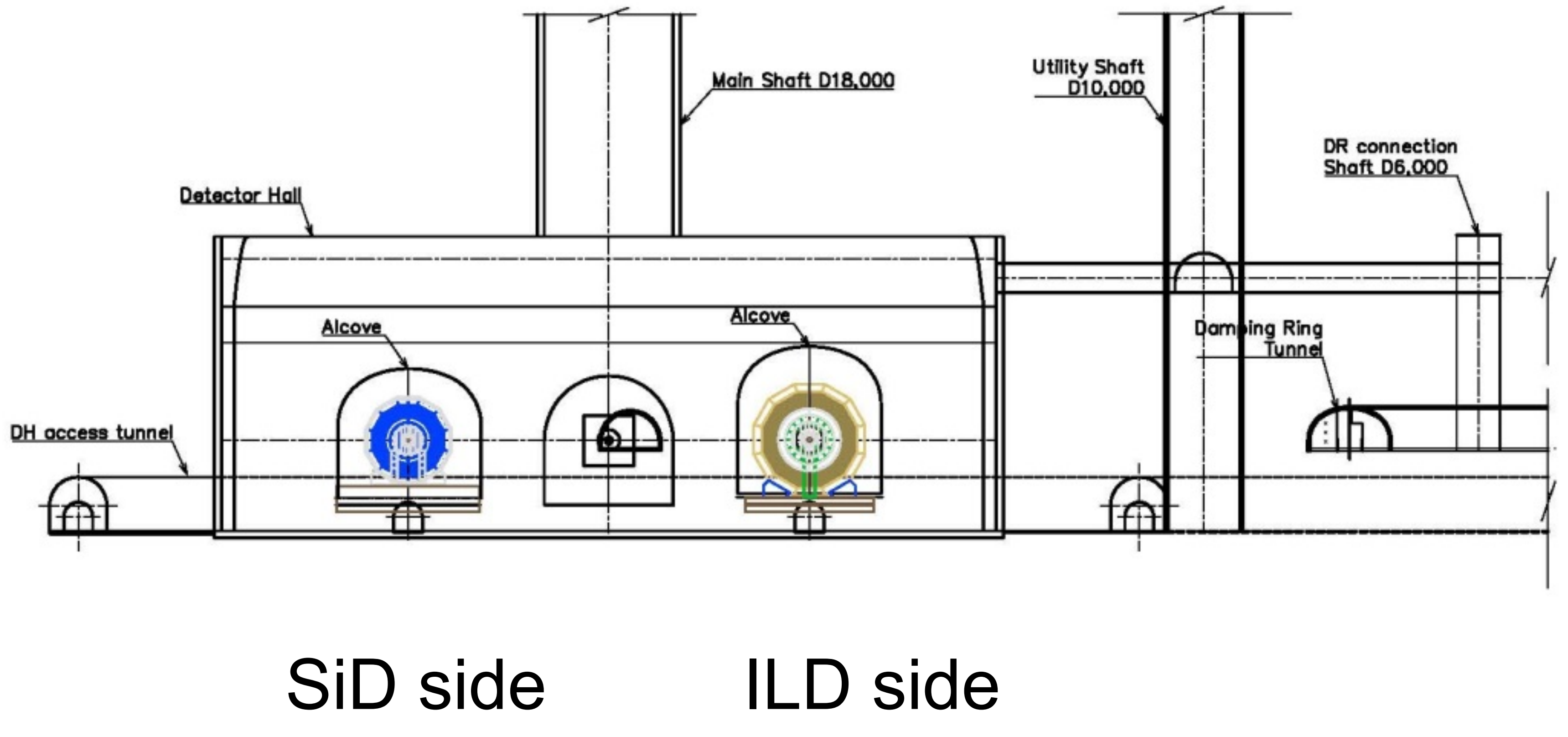
Slide from Alain Hervé

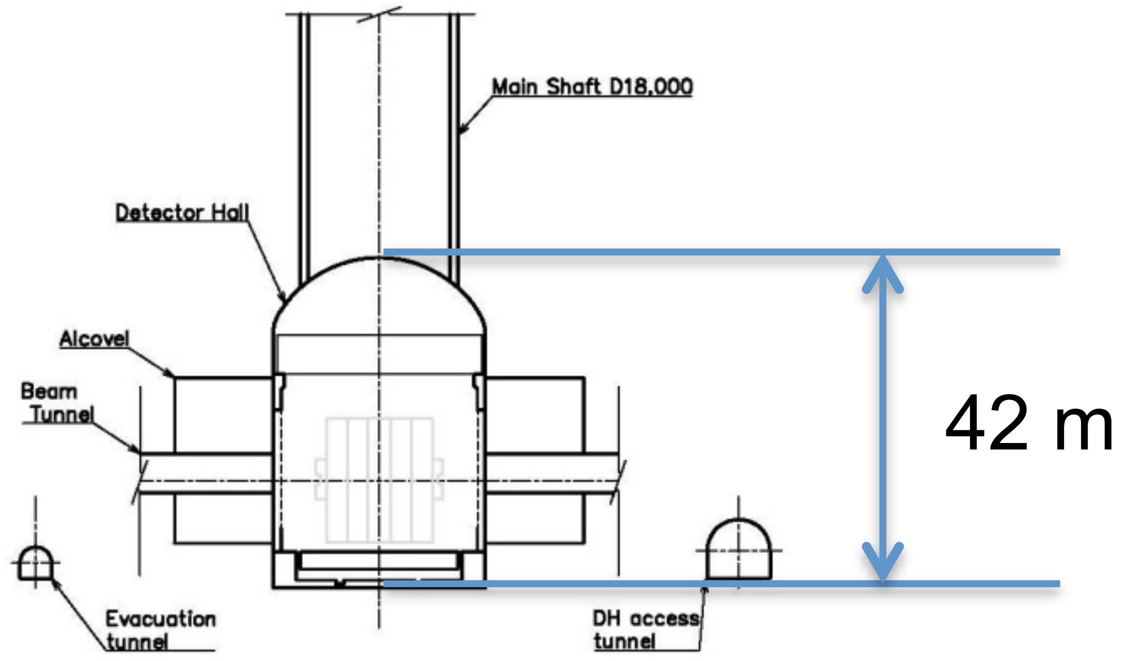
ILD-T_Workshop-PushPull-Considerations-4362.ppt A. Hervé 21/01/09

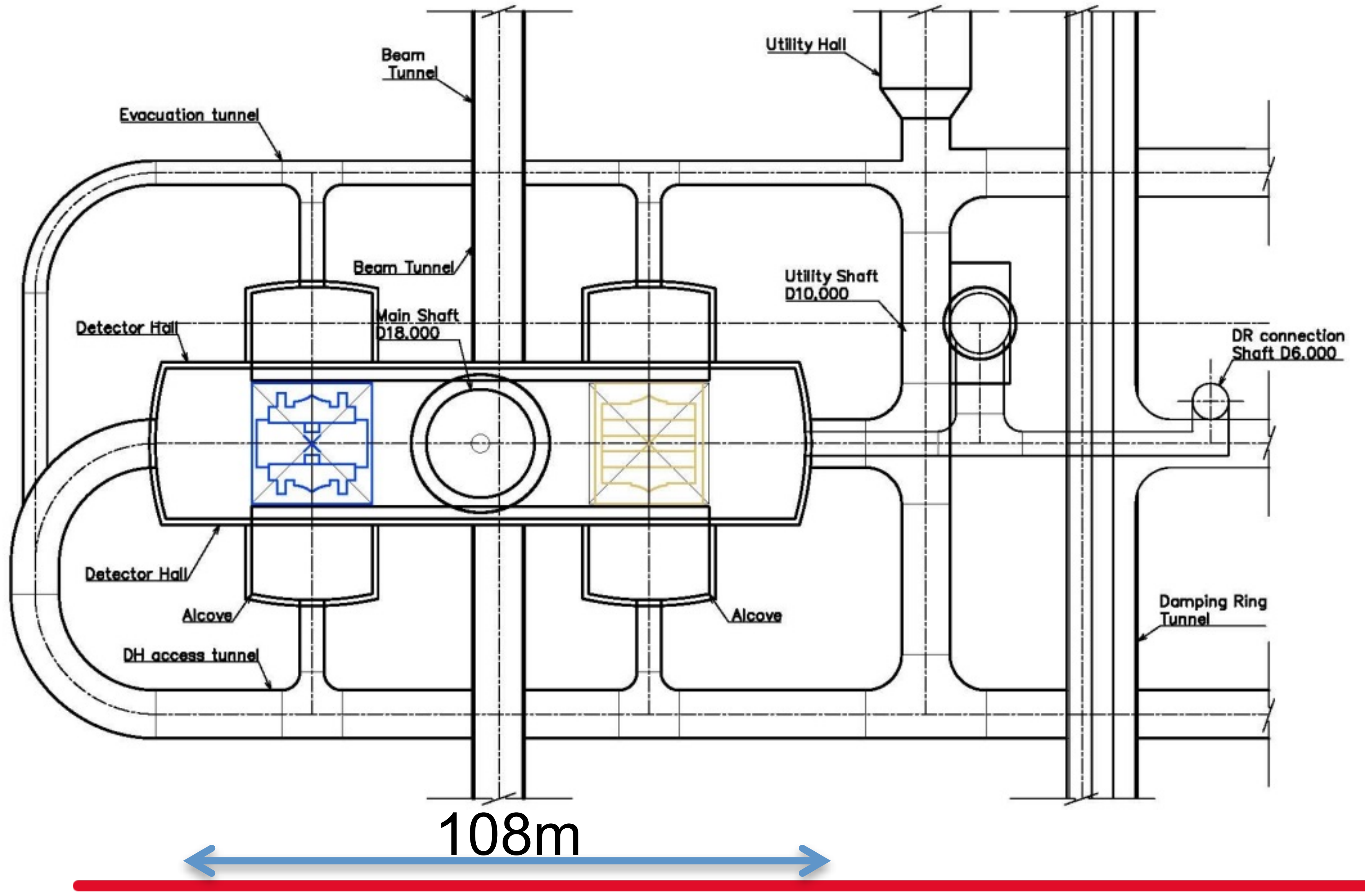
- Need an engineering study with both detectors and all services in the underground hall
- Need to review available space

Current Design of Detector Hall

Slide from Y. Nishimoto







- Main shaft locates IR position.
- DH length : 108m.
- Utility lines are in UT shaft
- Personnel entrance way is elevator installed in UT shaft
- Access tunnels connect at the both end of DH

Technical Detector Services

Detector Services

- Not seriously discussed since 2009
- Needs to be adapted to current underground hall designs!

Primary services

Facility	Output	Users
Water chillers	Water at 6 - 10 deg C	HVAC Electronics racks cooling Detector specific cooling (chilled fluids in range -30 / +25 deg C)
High to medium voltage power transformers	18 kV / 400V AC tri-phase	Lifts, cranes, general services Cooling & HVAC stations Primary power to detector electronics
Diesel & UPS facility	Secured power for valuable systems	
He storage & compressor plants	High pressure He at room temperature	He liquifier
Gas & compressed-air plants	Gas mixtures Compressed-air	Detectors chambers Process control valves, moving systems, …

Plants providing these services are usually located on surface, due to their dimensions and related risks.

Slide from Andrea Gaddi, 2009

Detector Services

- Not seriously discussed since 2009
- Needs to be adapted to current underground hall designs!

Secondary services

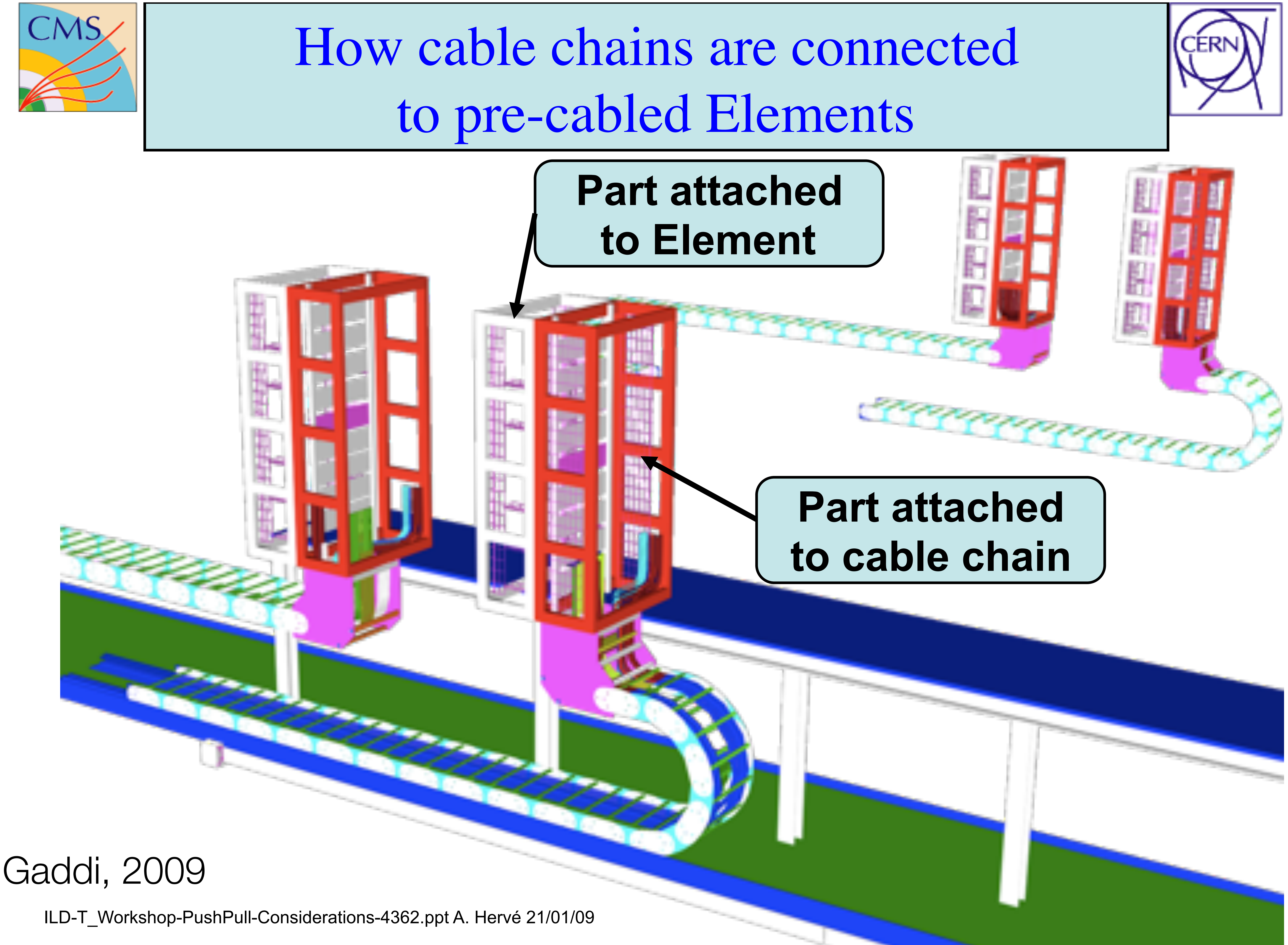
- Temperature-stable cooling water for sensitive detectors
- Low Voltage/High Voltage supply for front-end electronics
- Gas mixtures for drift-chambers
- UPS power for valuable electronics
- AC-DC power converters for superconducting coil(s)
- Cryogenics & Vacuum services

Secondary service plants need often to be close to the detector (low-voltage/high-current lines, cryogenics lines, etc) and they are located in the underground areas. Due to the push-pull design of the Interaction Region, these services are permanently connected and run into cable-chains toward the detector, regardless of their position in the Hall. To keep flexible pipes and cables in the chains within a reasonable length (< 50m), a service alcove for each detector is proposed at the main cavern ends.

Slide from Andrea Gaddi, 2009

Cable Chains and Detector Services

- Many services need to be attached to the movable detectors
- CMS design of cable chains has been adopted as conceptual design
- No study on this since 2009…



Slide from Andrea Gaddi, 2009

ILD-T_Workshop-PushPull-Considerations-4362.ppt A. Hervé 21/01/09

Cable Chains and Detector Services

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- No study on this since 2009…

How cable chains are connected to pre-cabled Elements

Part attached

On-board services

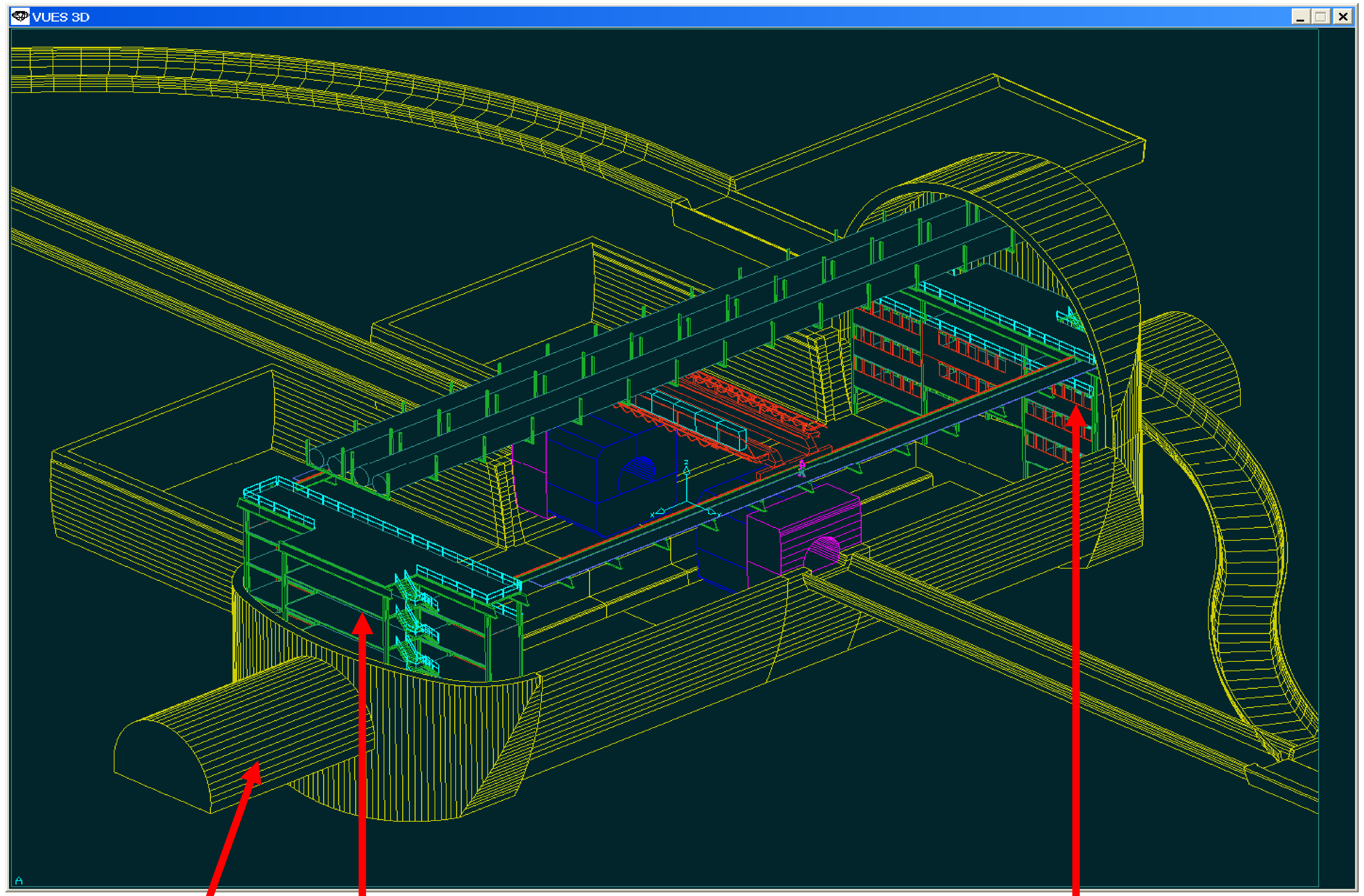
Some secondary services must be situated close to the detector as well, if the connection lines through the cable-chains is technically difficult or too expensive.
However this makes the size of the moving detector bigger with risks of inducing vibrations and electrical noise and <u>should be limited to a few special utilities, in a push-pull scenario, where detectors move every month or so.</u>

Slide from Andrea Gaddi, 2009

Detector Services

- Proposal in 2009:
- Service cavern at the end of the detector hall
  - NB: discussed for the old DH design (RDR)
- Idea for current design:
  - put services on service galleries around the underground hall
  - is this realistic? need a design!

Cavern space for infrastructures



No crane coverage. Only for light weight infrastructures (electronics racks)

Service alcove with light crane

Slide from Andrea Gaddi, 2009

Andrea Gaddi, CERN Physics Dept.

Detector Services

- Possible list of underground detector service facility (2009)
- Needs an update
- Can this fit on the hall service galleries?

List of systems housed in the "service-block"

Detector facilities located into the service cavern (not exhaustive list…):

- Electrical room for transformers & switchboards: LV system, electronics racks, UPS
- Cryogenics & vacuum system for magnet: He liquefier, rough vacuum pumps, …
- Electrical room for magnet power circuit: AC/DC power converter, breakers, …
- Ventilation & air-treatment skids
- Cooling skids for detector circuits: heat-exchangers, pumps, controls
- Gas room for gas mixture distribution/regulation
- Laser room for detector calibration
- Safety room: radiation monitoring, smoke detection, fire-fighting, …

Slide from Andrea Gaddi, 2009

Conclusion

- We are getting a better idea of the infrastructures that are needed for the detector assemblies
- Numbers of persons working at the IP campus have been estimated
  - need to update them in view of improving detector assembly schemes
- We have to focus also on the underground services and distributions
  - No coherent plan for the current detector hall design
  - ILD did some studies in 2009, not followed up since then
    - partially because at that time it was too early, as many sub detector requirements were not known
  - Need to re-work the requirement lists in view of current understanding on read-out systems, etc:
    - power supplies, coolers, gas systems, safety, fire prevention, etc. etc.
- We need to adapt the planning to the possible new IP location!

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