

Detector Hall Update

2021/03/18

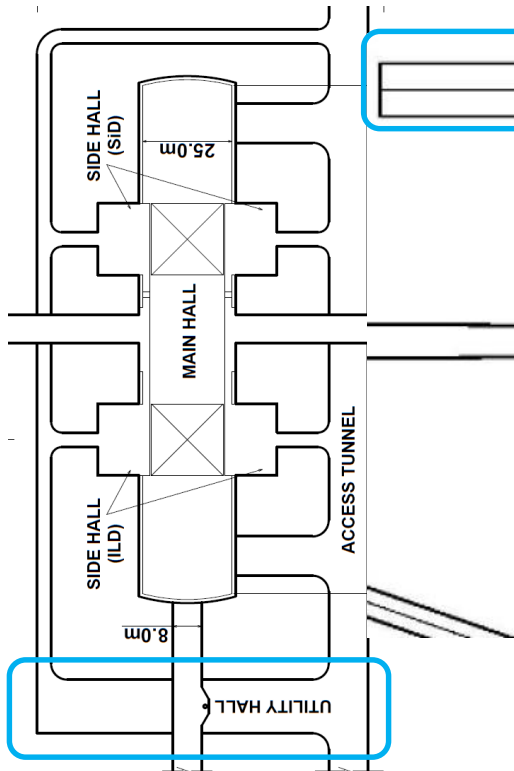
@LCWS2021

Yasuhiro Sugimoto

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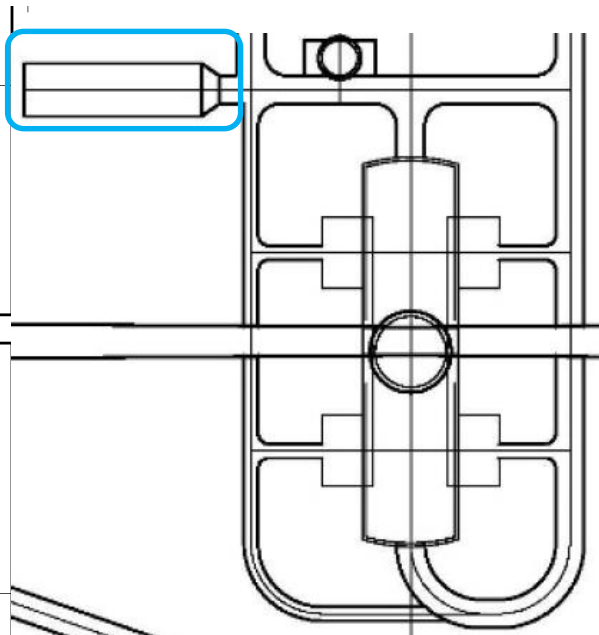
- Detector Hall and Utility/Service Cavern
- Assembly Hall and Pre-assembly Hall
- Open Questions
- Summary

DH and USC designs so far



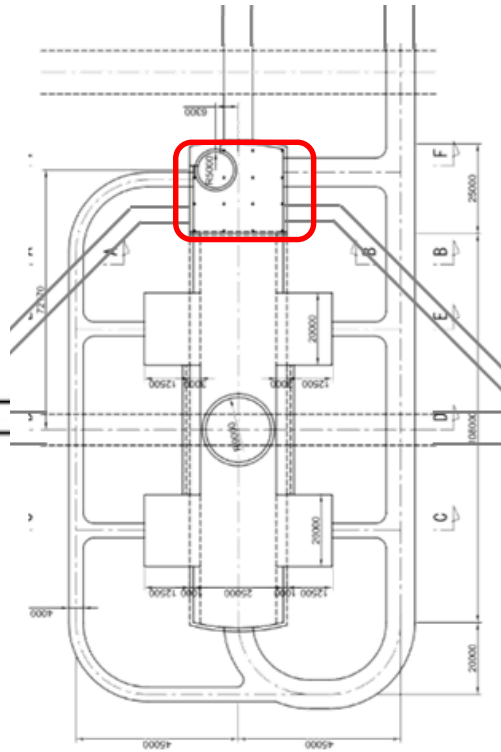
TDR

- 1200 m²
- Asymmetric wrt detectors
- **Obsolete**



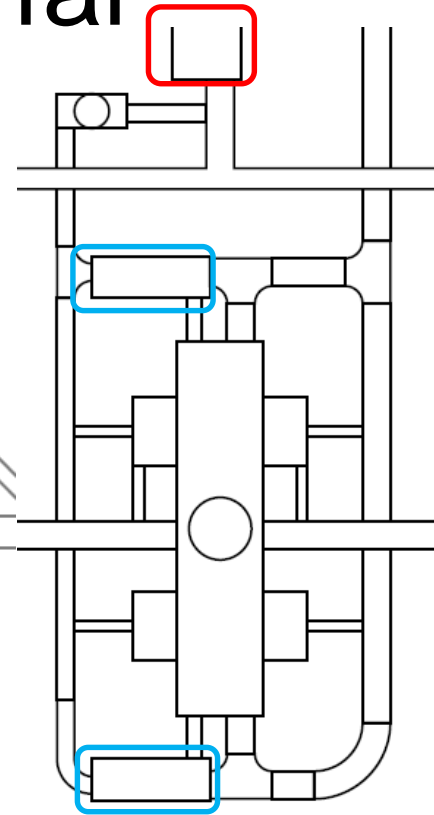
TDR-Mod'

- 750 m²
- Asymmetric wrt detectors
- **Dead-end**



Tohoku design

- USC attached to DH
- Bypass tunnels connecting USC and beam tunnel
- **Utilities for accelerator only**

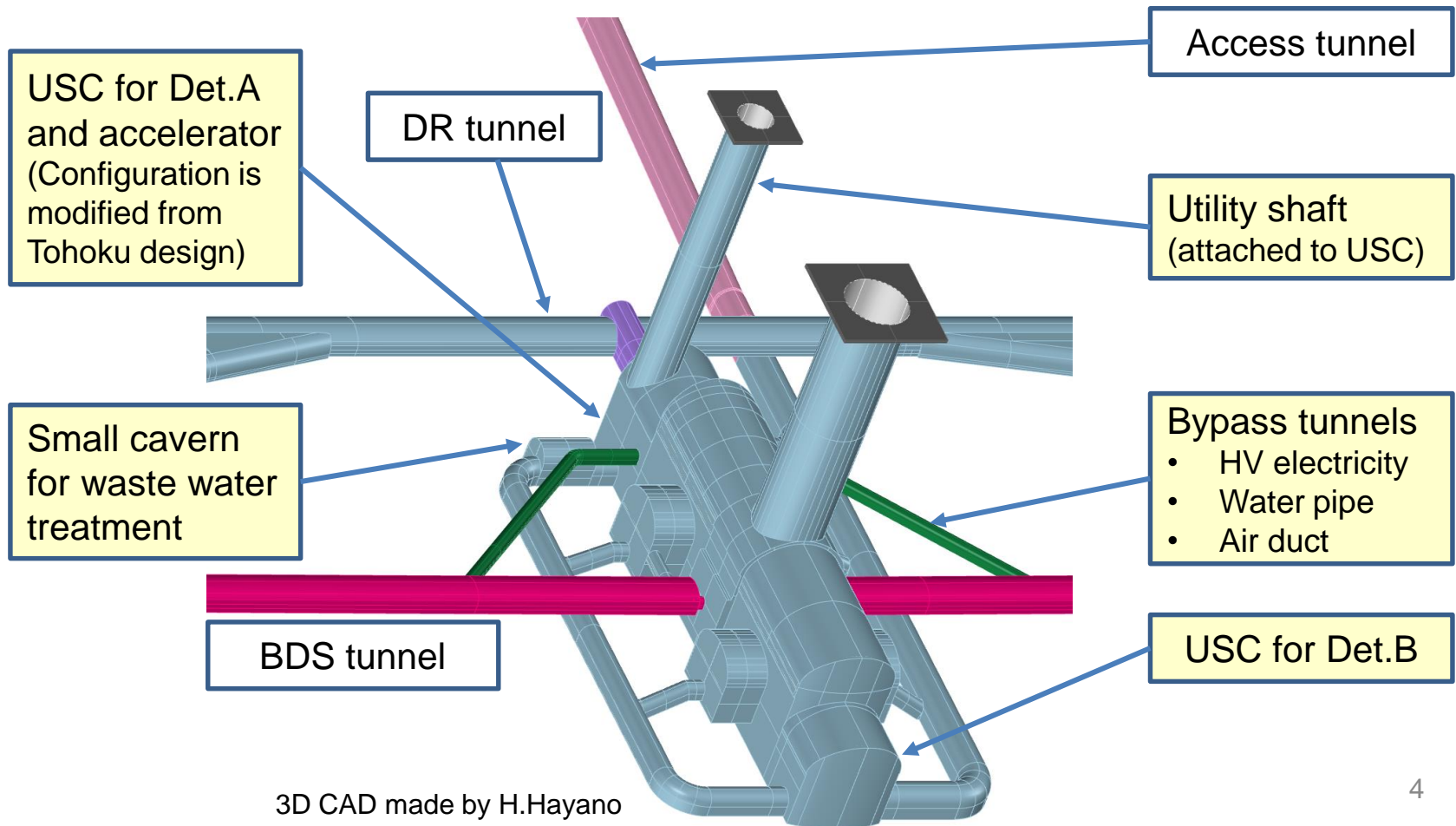


Proposal by Y.S.

- 408 m² x2
- Symmetric wrt detectors
- Separate accelerator USC
- **66kV power lines cross DR**

Compromised design

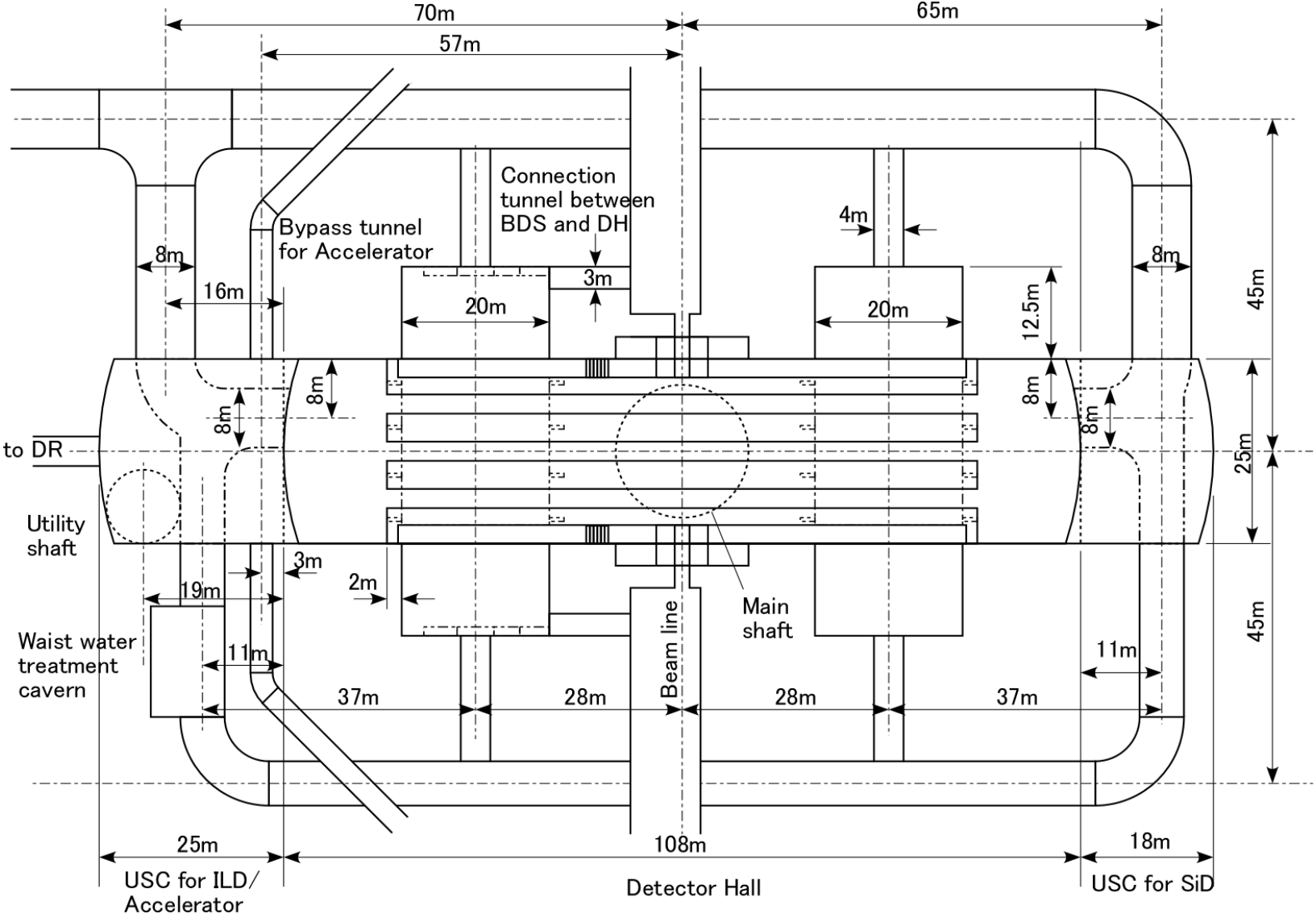
- There has been several designs of Detector Hall (DH) and Utility/Service Cavern (USC)
- After discussion with accelerator people, a compromised design acceptable for both acc. and det. Has been made



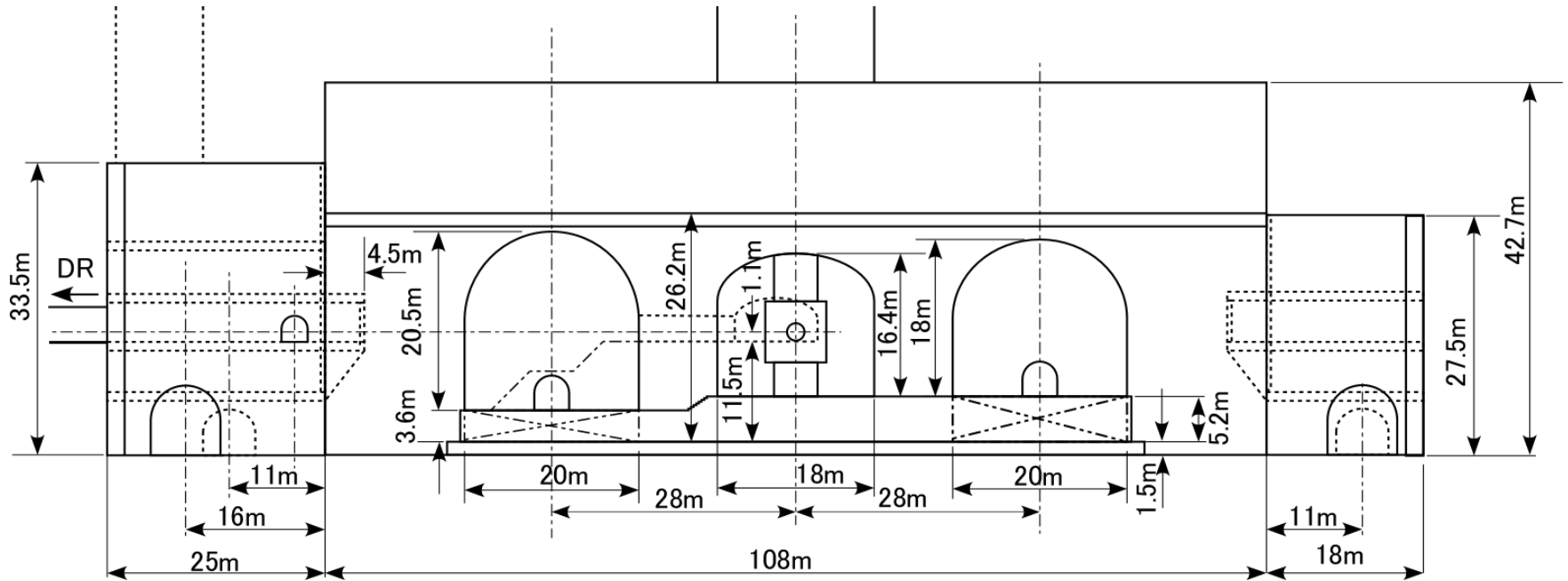
USC configuration

Tohoku design		Compromised design	
5F	HVAC	On surface	
4F	HVAC	5F	Cooling systems for ILD LASER system for ILD Workshop
3F	Cooling water for Acc.	4F	Cooling water for Acc.
2F	Transformer for Acc.	3F	Transformer for Acc. Transformer for ILD
1F	Helium cryogenics Water treatment	2F	Cooling systems for ILD
		1F	He cryo for QF1 Cooling systems for ILD Cooling water for ILD

DH and USC

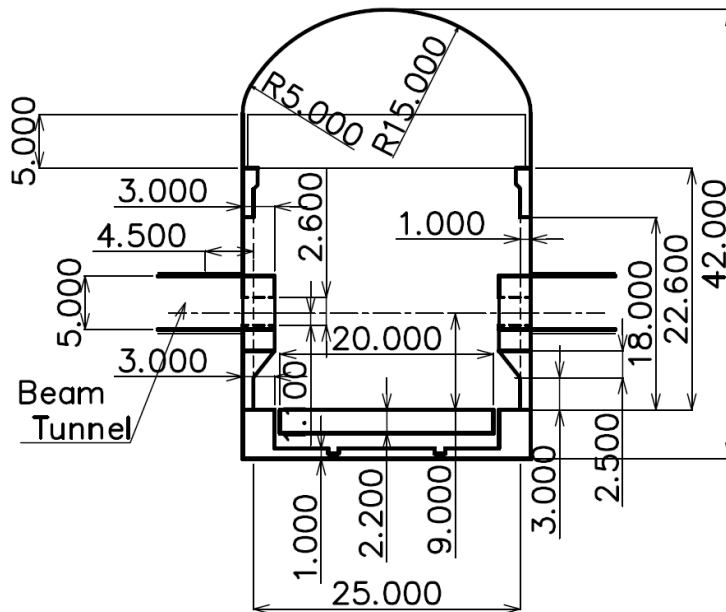


DH and USC

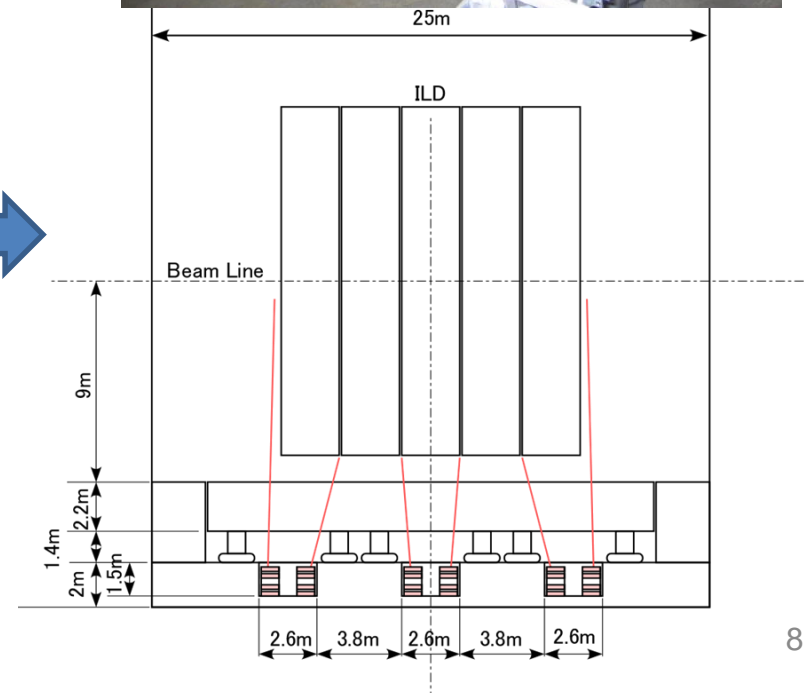


Other minor changes from TDR-mod

- Cable trench
 - In the TDR design, depth of the cable trenches is only 50cm
 - Apparently, this is too small for cable chains
 - New proposal:
 $2.6\text{m}(0.8\text{m}\times 2+1\text{m})\times 1.5\text{m}\times 3$
 - Each trench houses two cable chains and space for human access



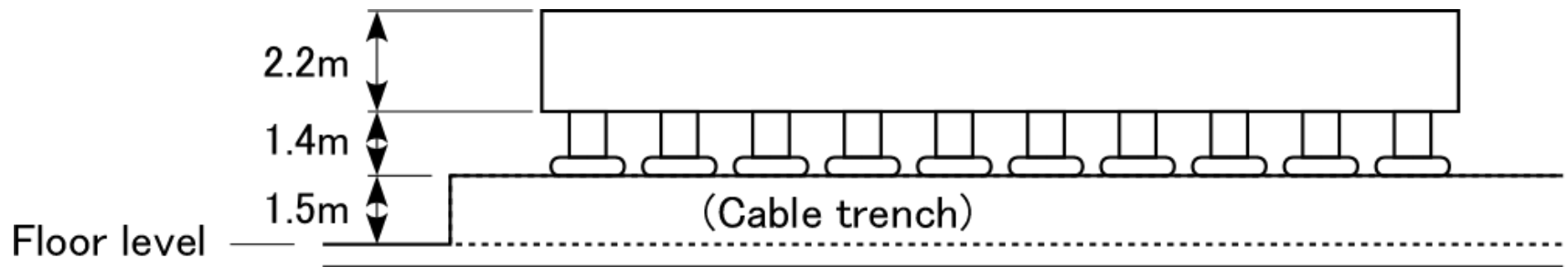
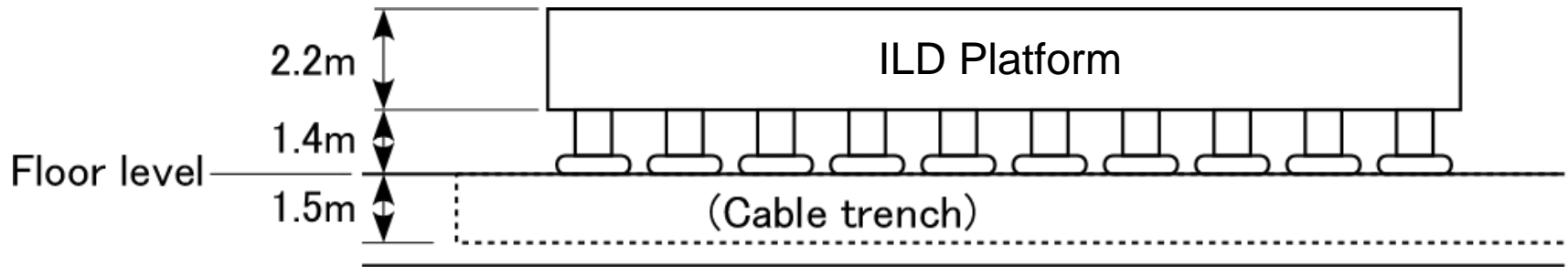
TDR design



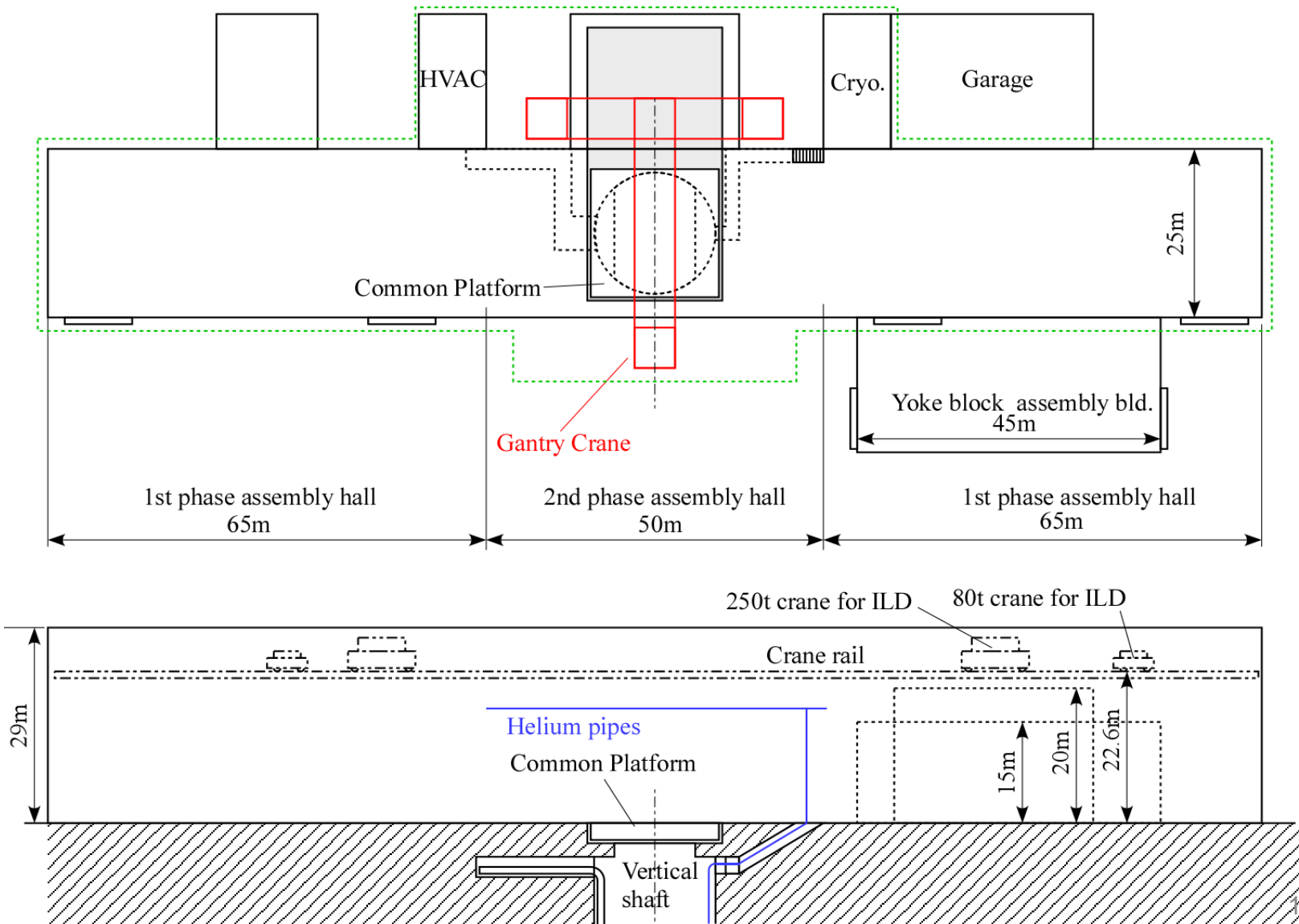
Other minor changes from TDR-mod

- Floor level
 - DH floor level is lowered by 1.5m
 - Same level as bottom of the cable trench
 - Floor level of USC and surrounding tunnel is also lowered by 1.5m
 - Merits:
 - Clearance between access tunnel and DR/BDS tunnel becomes larger
 - In case of emergency (power shortage for water pumps), more time allowance before water level goes up to detector level

Floor level

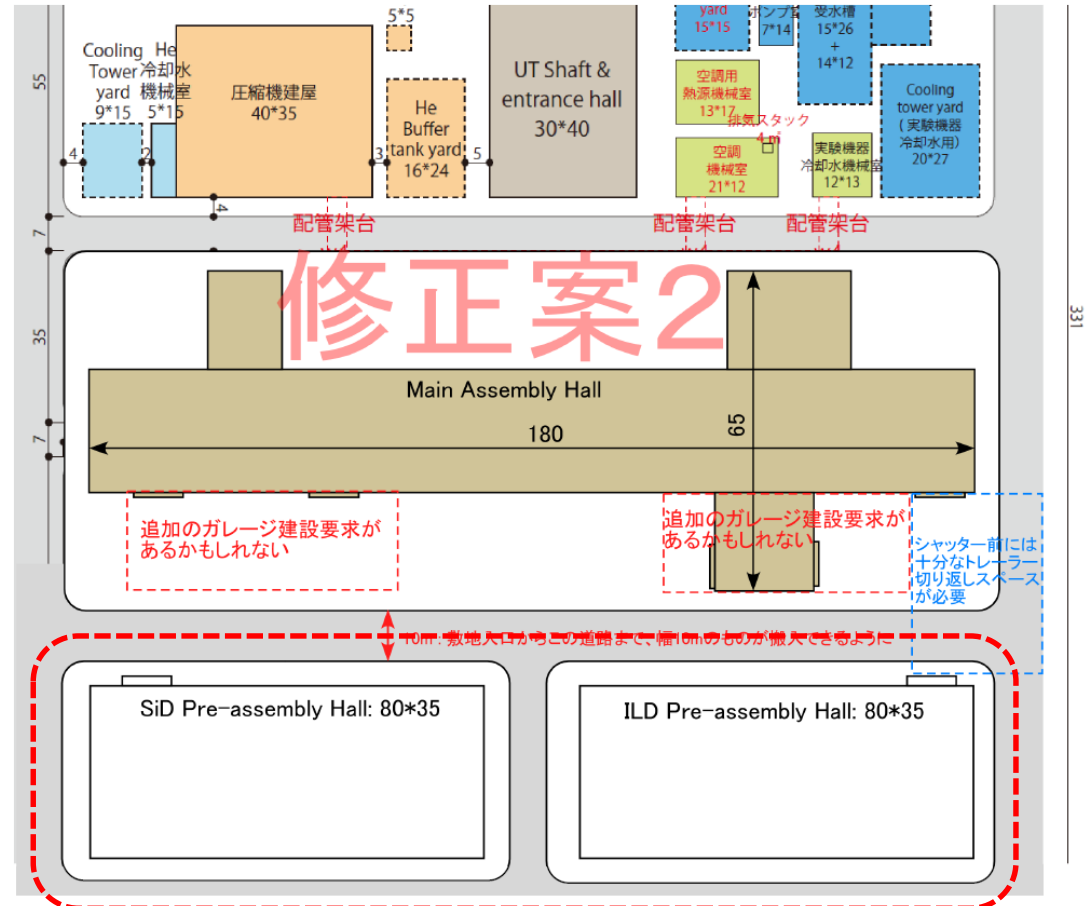


Assembly Hall



Pre-assembly Hall

- Pre-assembly halls are used for sub-detector assembly and test
- Area of Pre-AH for each detector is 80mx35m
- Height of the buildings depends on the sub-detector assembly procedure, and has to be fixed
- No detailed design yet



Open questions

- Design shown here is just a draft proposal
- More detailed design has to be made during the early phase of Pre-Lab period
 - Gantry crane : Much heavier load than CMS
 - Moving platform : Much heavier load than CMS
 - Rotating shield : Much heavier than CMS
 - QD0 support (and longer L*)
 - etc.
- Feedback is necessary from
 - Detector side
 - Accelerator/CFS side
 - Civil engineering experts (company)
 - We can expect some amount of resources for CFS study from Pre-Lab

Detector assembly timeline

- Tatsuya Nakada' presentation at AWLC2020
 - Detector proposals will be approved by ILC-Lab, not by Pre-lab
- This statement seems reasonable: ILC Lab is responsible for ILC construction
- So far, we have assumed approval of detector technical proposals will take place **2 years before the start of ILC construction** (Ground Breaking), and drawn the timeline of ILD assembly based on this assumption
- In the new assumption, the completion of ILD assembly could be delayed by >2 years

Detector assembly timeline

- Impact on design of DH/AH
 - Design of the DH/AH depends on the detector design (particularly their sizes)
 - The detailed design of DH/AH has to be fixed well before ground breaking, but the approved detectors are not decided at that time
 - What shall we do?
 - Imposing detector size similar to ILD and SiD on the detector candidates at the detector proposal call?
- Possible additional delay
 - Collaboration formation and decision of work sharing
 - Acquisition of budget in each country after approval of the detector proposal
 - ...
- Can we build detectors in 10 years after GB?

History of CMS

- 1993 LOI approved
- 1994 **Technical Proposal (~250 p) approved**
- 1996 Approved to move to construction
- 1997 **The Magnet Project TDR (~290 p)**
- 1998 MoU for construction
- 1998 **Construction started after approval of sub-system TDRs**
- 1999 **Coil design frozen**
- 2000 CMS assembly in assembly building started
- 2002 **Coil modules construction started at the factory**
- 2004 Underground cavern completed
- 2004 **Connection of modules started at assembly building**
- 2005 **Insertion of solenoid coil into vacuum vessel**
- 2006 **Coil cooled down and exited to 4T**
- 2006-2007 Detector lowering
- 2007 Barrel sub-detectors installation
- 2008 **Ready for beams**
- 2009 First collisions



14 years

Summary

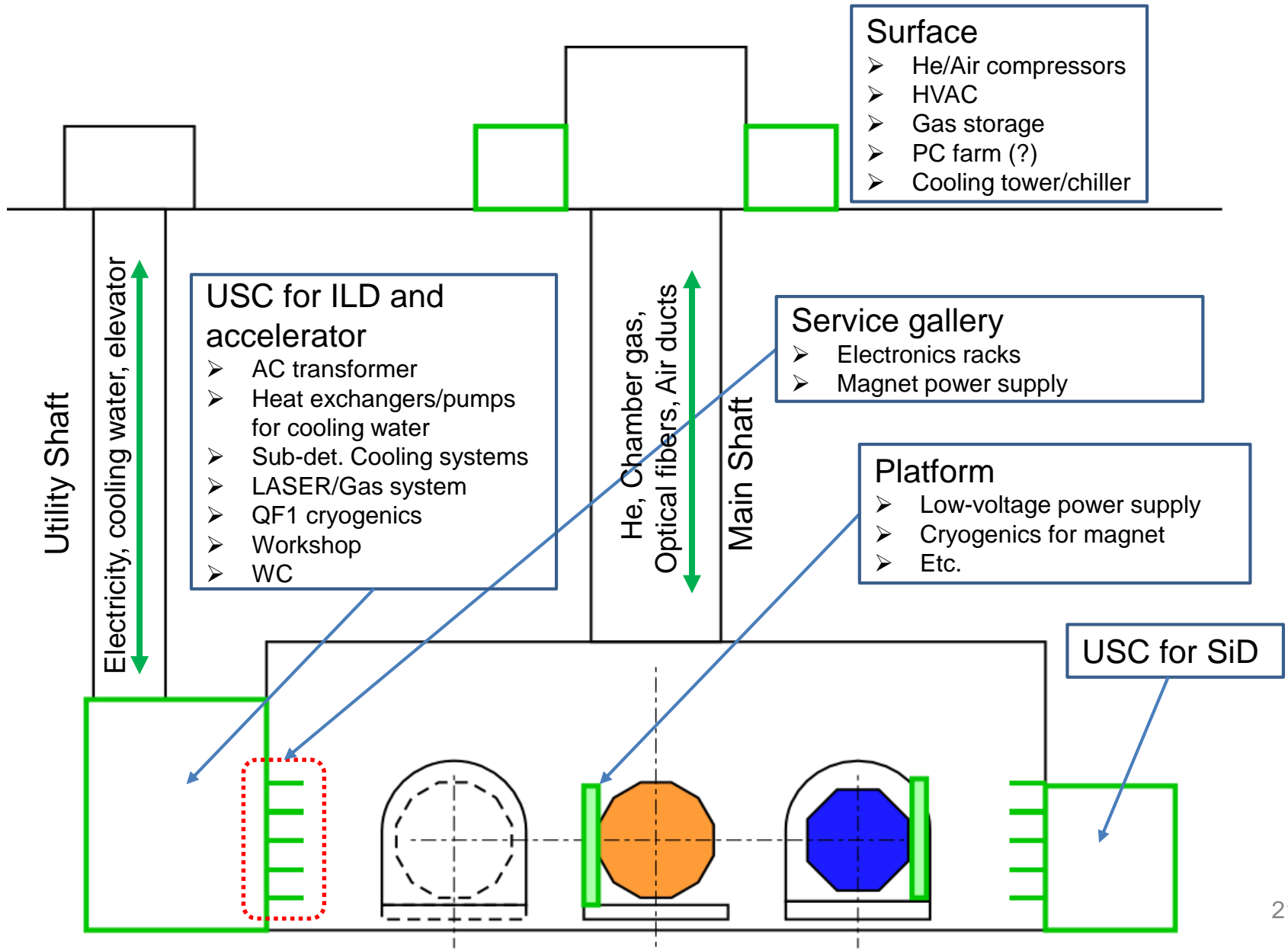
- A part of updates of design of DH/AH has been shown/proposed in this presentation
 - Feedback is welcome → WG3 MDI subgroup
- Timeline of design and construction has to be re-considered
 - How to build the detectors in <10 years after proposal approval?
 - **How to decide the DH/AH design before approval of detector proposals?**

BACKUP SLIDES

Cable trench

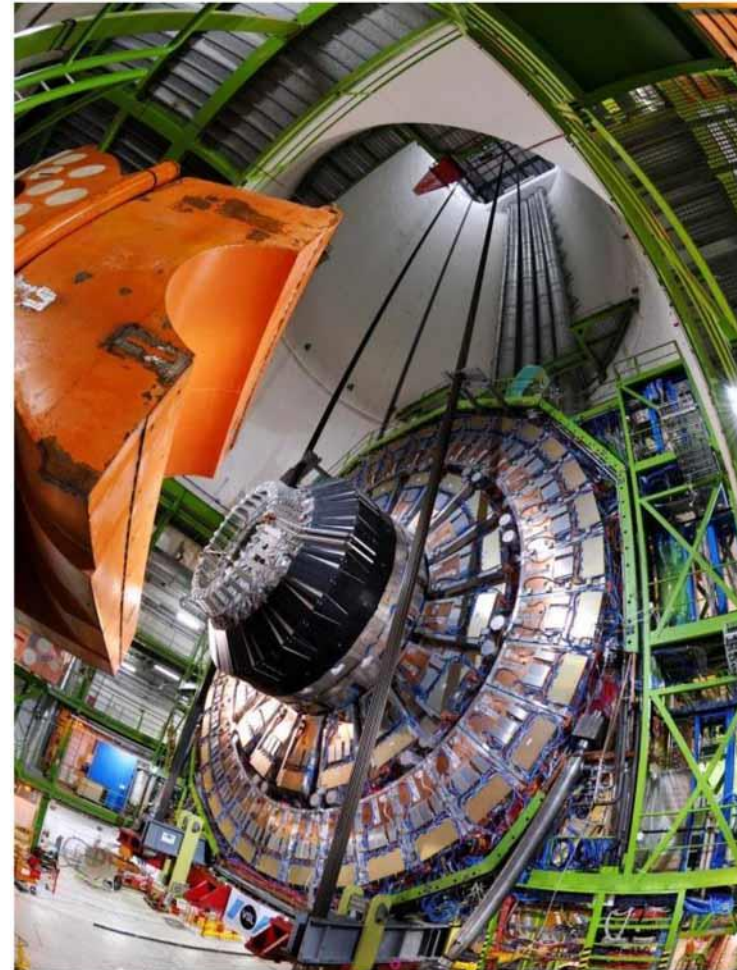
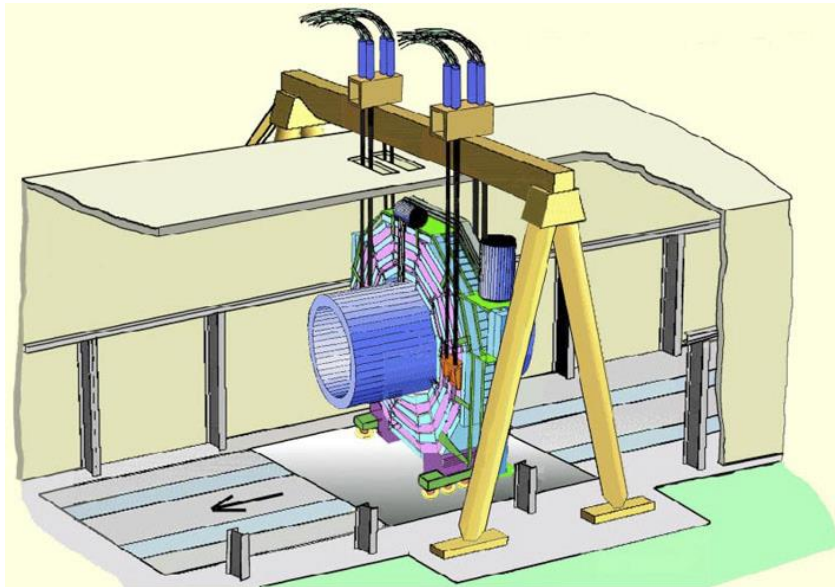
- Cross section of cables/pipes
 - Estimation by C. Clerc at ILD software and Integration Workshop at DESY, 2010
 - Cross section of cables/pipes for TPC, ECAL, and HCAL through the gap between YB0 and YB1 is $\sim 1200\text{cm}^2$
 - If contribution of muon det. is added, it would be $\sim 1400\text{cm}^2$
 - We assume $\sim 1600\text{cm}^2$ cables/pipes come out from each gap

Utilities/Services



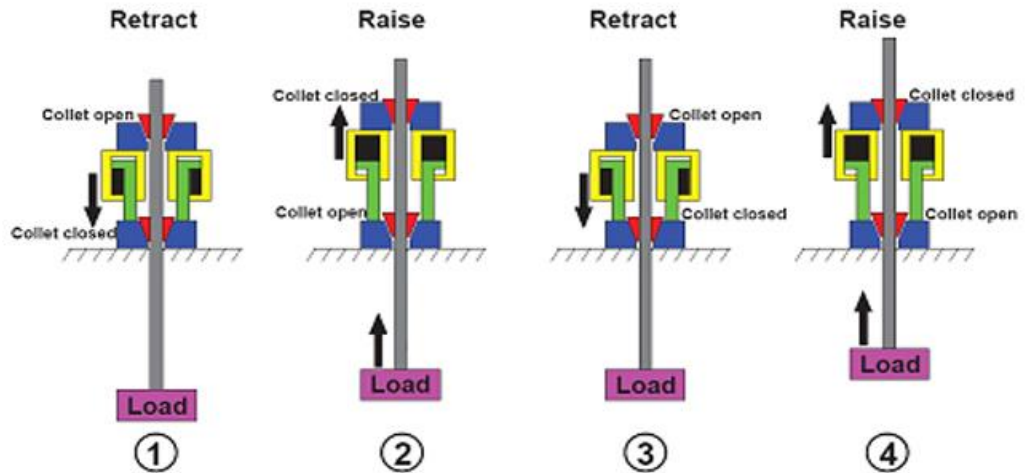
Gantry crane

- ILC detectors will be lowered from the surface to DH as big pieces (max. 4000t) using a gantry crane
- CMS experiment used 2000t gantry crane, but feasibility of 4000t gantry crane is not obvious



Gantry crane

- Open questions
 - Strand jacks and their configuration
 - Support frame
 - Foundation under support frame

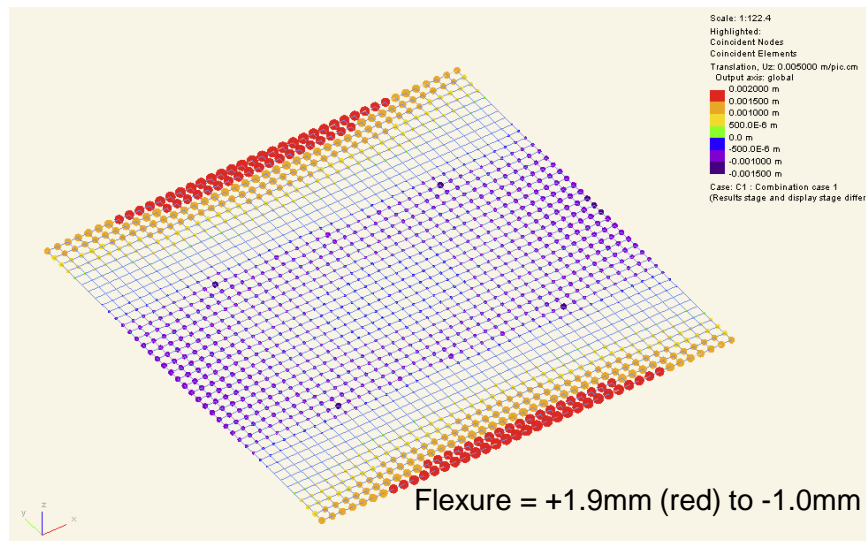


Rotating shield

- Rotating shield around the beam line is envisaged for ILC → called as “Pac-man”
- CMS has the similar mechanism
- Open questions
 - Compared to CMS pac-man, ILC requires much heavier packman
 - CMS: 100t \leftrightarrow ILC: >300t
 - Limit is 160t for CMS cavern wall (CMS NOTE 2000/068)
 - Can ILC pac-man be supported from the wall?
 - Can we make the pac-man thinner?
 - Sliding shield as an alternative?

Moving platform

- We need two kinds of moving platform
 - In detector hall for push-pull operation
 - In assembly hall for detector lowering
- Some studies have been done for the platform in DH
- Study for the platform in AH is not sufficient
 - Platform in AH can be supported only at the edge
- More detailed design is necessary for the structure and the moving system (→ possible impact on design of DH/AH)

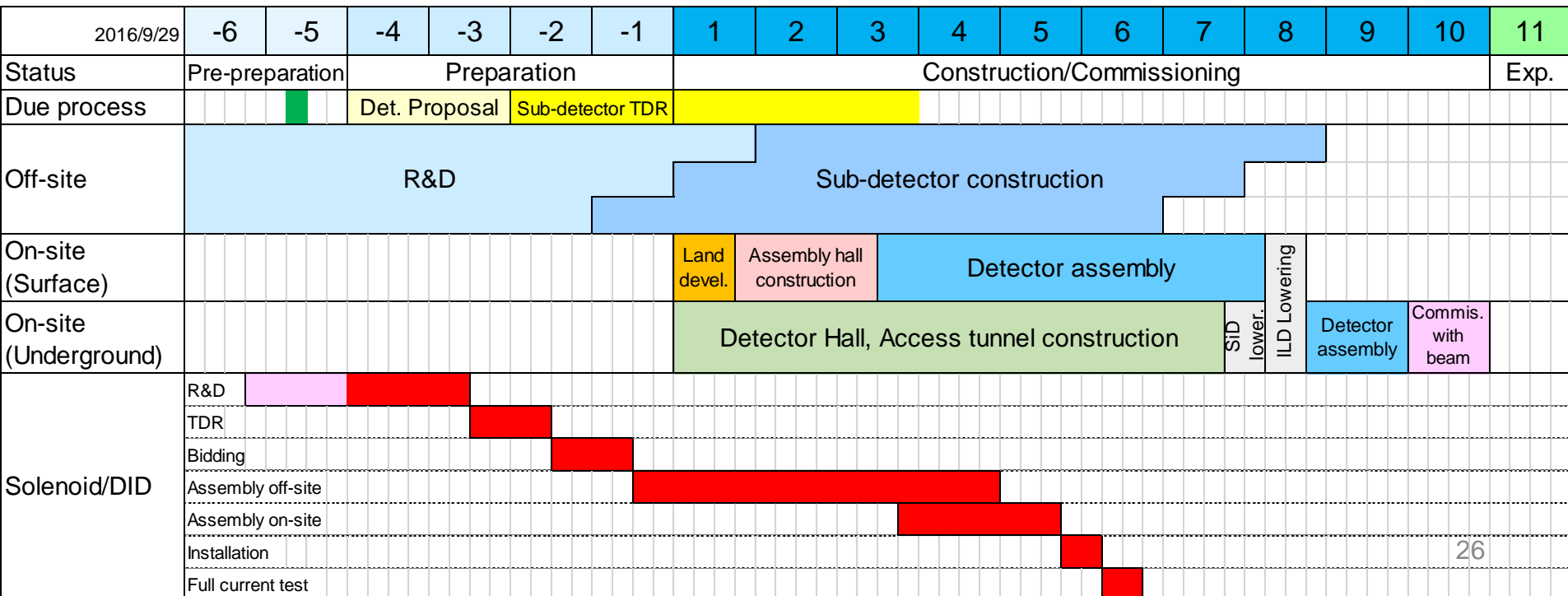


Platform with ILD load during movement



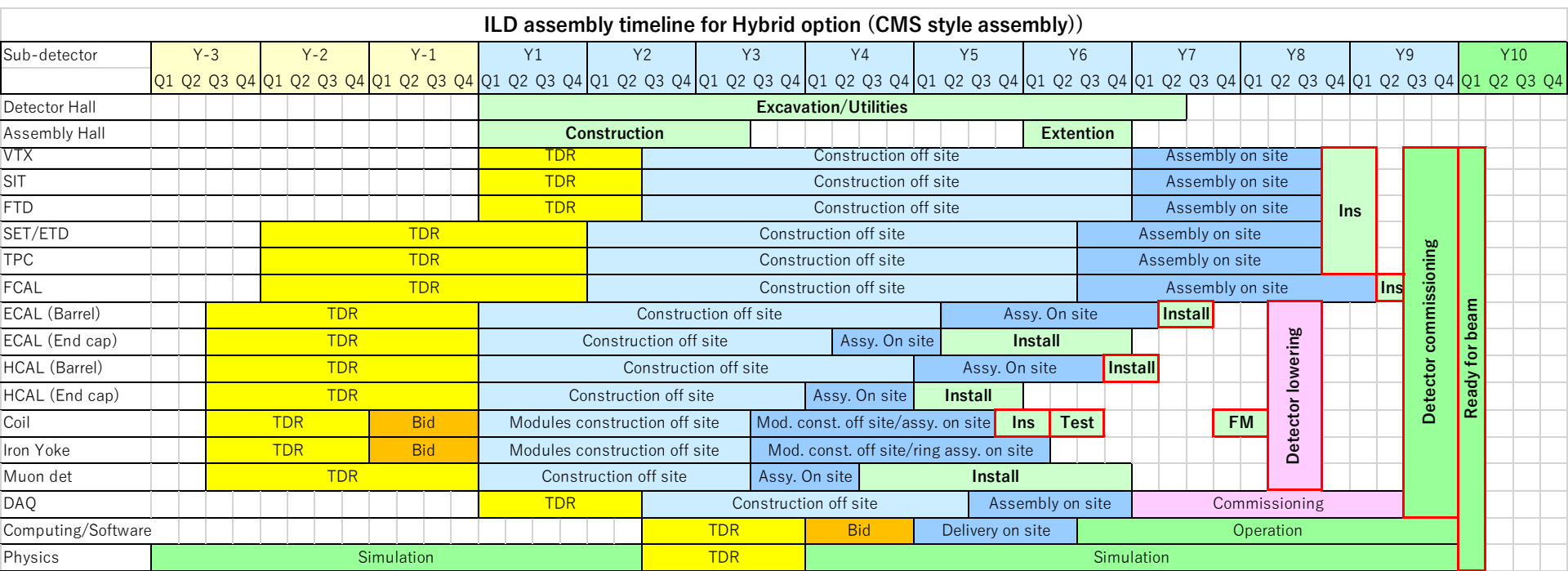
Assumed assembly timeline

- Proposal approval 2 years before ILC ground breaking (G.B.)
- Solenoid TDR approval 0.5 y after proposal approval
- Solenoid module construction starts 0.5 y before G.B.
- Solenoid assembly starts 1Q after Assembly Hall completion
- Solenoid installation completes 6 y after G.B.
- Detector construction in 9 years (+1 year commissioning)



Impact on the ILD Timeline

- Completion of solenoid assembly/installation will be delayed by ~3 years
- It is impossible to make the detector assembly period shorter only by re-configuration of order of sub-detector installation
- If the start of solenoid construction is delayed by 3 years, coil winding on site (AH) can be an option (So far, we have assumed coil winding at the factory)



Pre-lab physics and detector activities

- **Preparing the ILC physics programme** by
 - setting up the ILC Committee (ILCC) as a programme committee for the ILC at the start of the Pre-lab.
 - Call for Expressions of Interest (EoIs) after ~ 0.5 year for experiments covering a broad physics spectra which can be done at the ILC.
 - Call for Letters of Intent (LoIs) about one year after the EoIs. The ILCC will select a subset of LoIs to proceed for the next step.
 - Call for a Technical Proposal/Technical Design Report shortly before the transition to the ILC Laboratory, where the final approval of the experiments will be made by the ILC Laboratory.
- **Approving and monitoring of the progress for the detector R&D programme** by the ILCC.
- **Organising occasional physics workshops** to reflect on the on-going progress relevant for the ILC physics.

This timeline is the current IDT thoughts and the actual implementation will be led by the Pre-lab directorate

(See the afternoon plenary session on Thursday 22nd with Google Doc question possibility)

T. Nakada, 6

How to catch up with the Acc. schedule

- Bonus of 1 year
 - We thought the ILC design change from 500GeV to 250GeV could make the accelerator construction period (originally, 9 years for construction + 1 year for commissioning) shorter by 1 year
 - Therefore, we made the ILD assembly schedule completed in 9 years, including detector commissioning (see previous page)
 - But acc. construction period does not seem to become shorter
 - So we have 1 year margin
- Reconsideration of solenoid assembly period
 - Coil winding on site could make the assembly period shorter
 - If we discard the anti-DID, we can reduce the construction period (and cost) → $L^*=6\text{m}$ is an attractive option
- Reconsideration of installation period of barrel sub-detectors
 - We might be able to squeeze ~1 year by reducing the installation period of each sub-detector by ~30% (6 month → 4 month for each)
- Quick approval of detector proposals
 - If the proposals are approved just after the start of ILC-Lab, we can get another 1 year

Detector integration procedure

- Detector integration procedure on surface has to be clarified in order to make the design of Assembly Hall
- The integration procedure is detector-concept specific
 - We can't make the final design until approval of detector proposals, which happens after ground breaking
 - A possible solution
 - Common design for the main building
 - Specific designs (assume ILD and SiD) for side houses
 - Design change of side houses in 3/4 year from ground breaking, if necessary

Assembly Hall

