

Detector Utility

2019/10/30

Yasuhiro Sugimoto

@LCWS2019

Contents

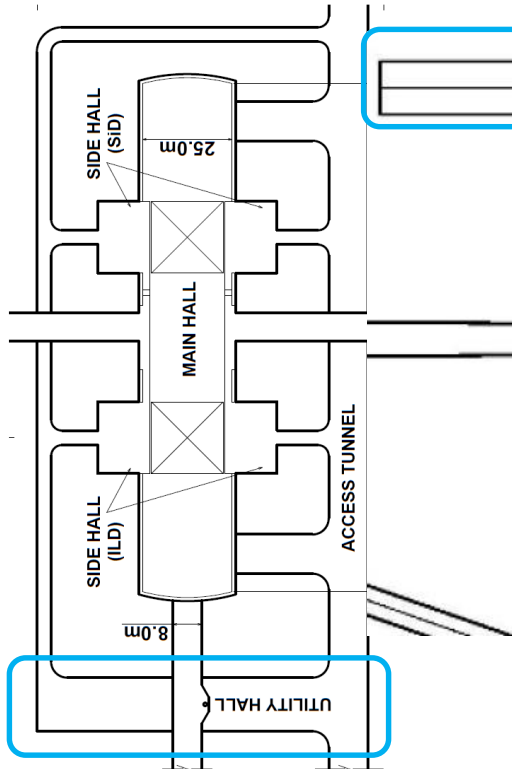
- Utility Cavern/Detector Hall
- Transportation to underground
- Utility requirements in construction period
- Summary

UTILITY CAVERN / DETECTOR HALL

Utility Cavern designs

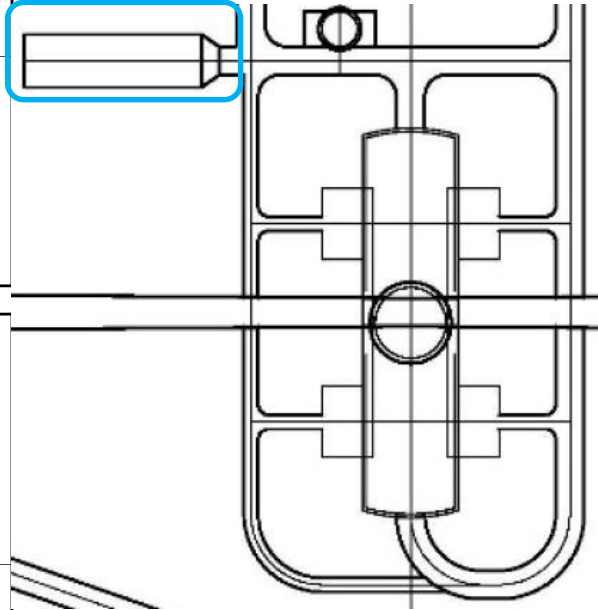
- Several designs of Utility/Service Cavern (USC) have been proposed so far
 - TDR
 - TDR-mod'
 - Design by Tohoku team
 - Y. S.'s design
- Each design has demerits
 - Tohoku design has no space for detector utility
 - In Y. S.'s design, accelerator utility cavern has to be build on the other side of Damping Ring Tunnel → 66kV AC lines run close to Damping Ring → Some risk for DR operation
- We should move to an acceptable design for everyone
 - ➔ A compromised design is proposed in this talk

USC designs



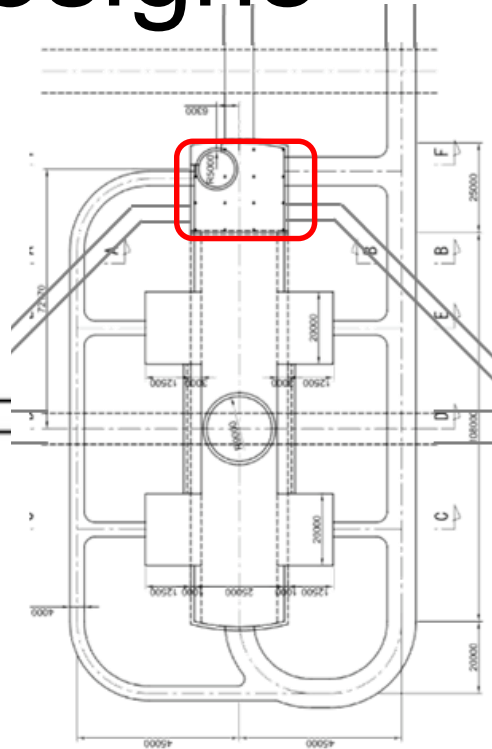
TDR

- 1200 m²
- Asymmetric wrt detectors
- Obsolete



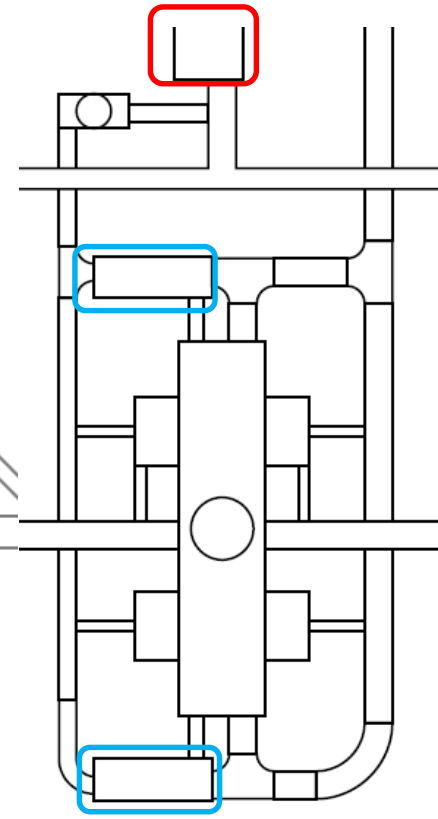
TDR-Mod'

- 750 m²
- Asymmetric wrt detectors
- Dead-end



Tohoku design

- Utilities for accelerator only
- Asymmetric wrt detectors, even if there is enough space



Proposal by Y.S.

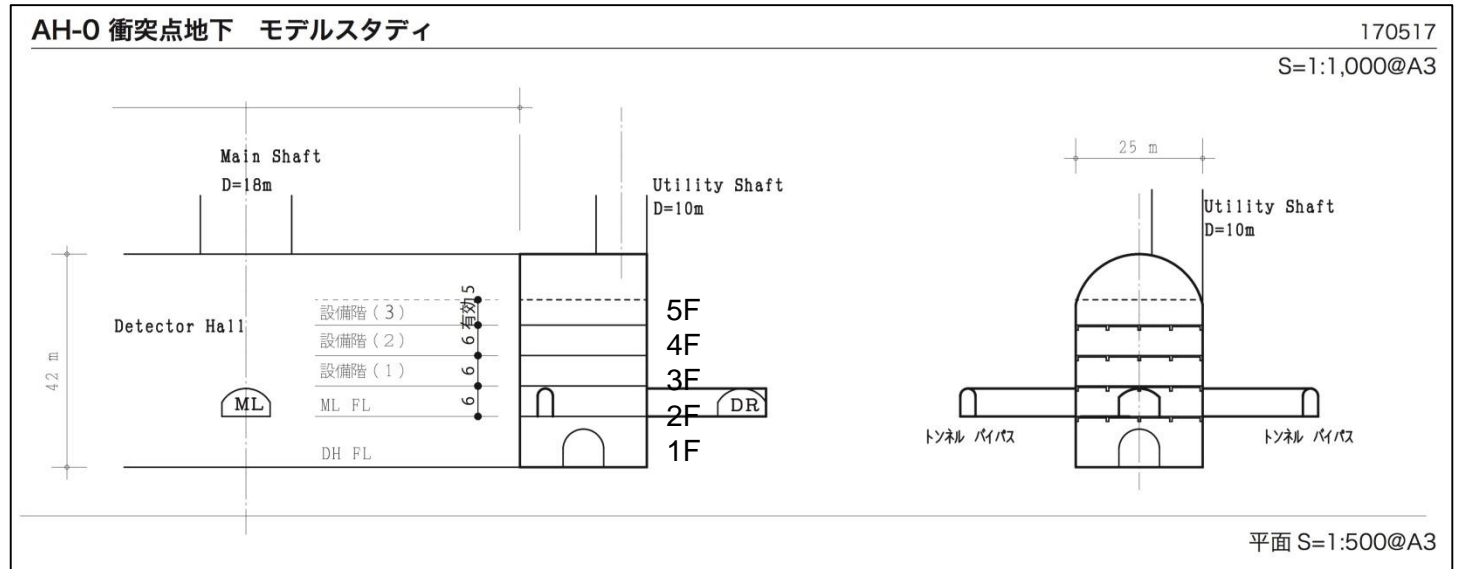
- 408 m² x2
- Symmetric wrt detectors
- Separate accelerator USC

A compromised design

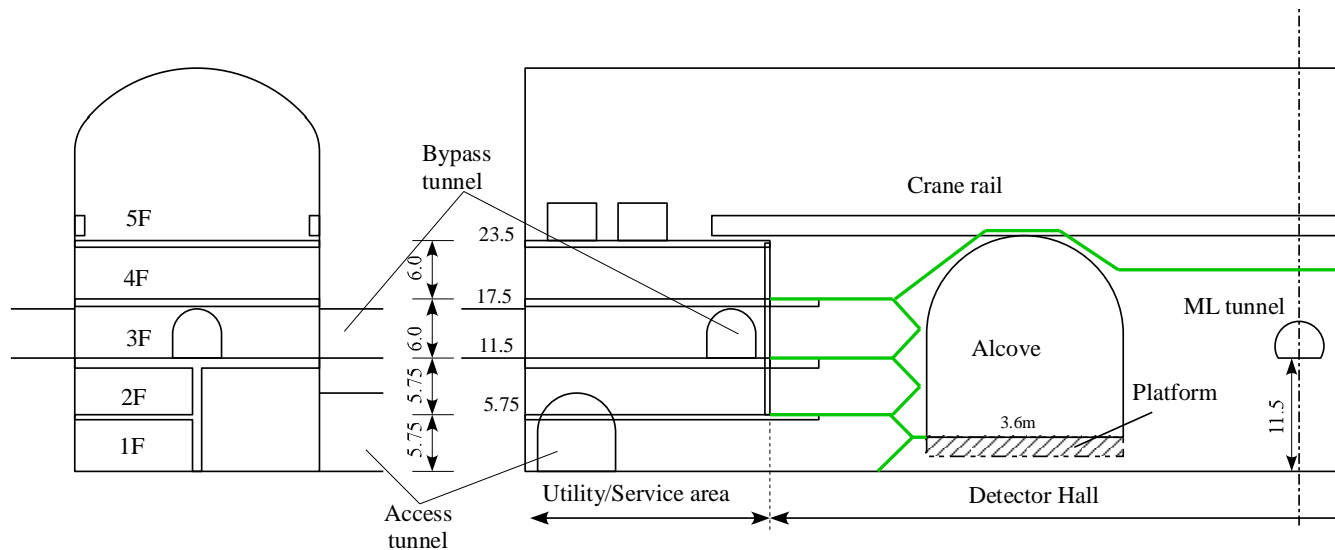
- USC is attached to DH, and Utility Shaft is connected to USC
- Configuration in the USC is modified from Tohoku design to create enough space for ILD utility
- Additional USC for SiD is attached to DH on the opposite side to keep symmetry wrt two detectors

USC configuration

Tohoku
design



New design

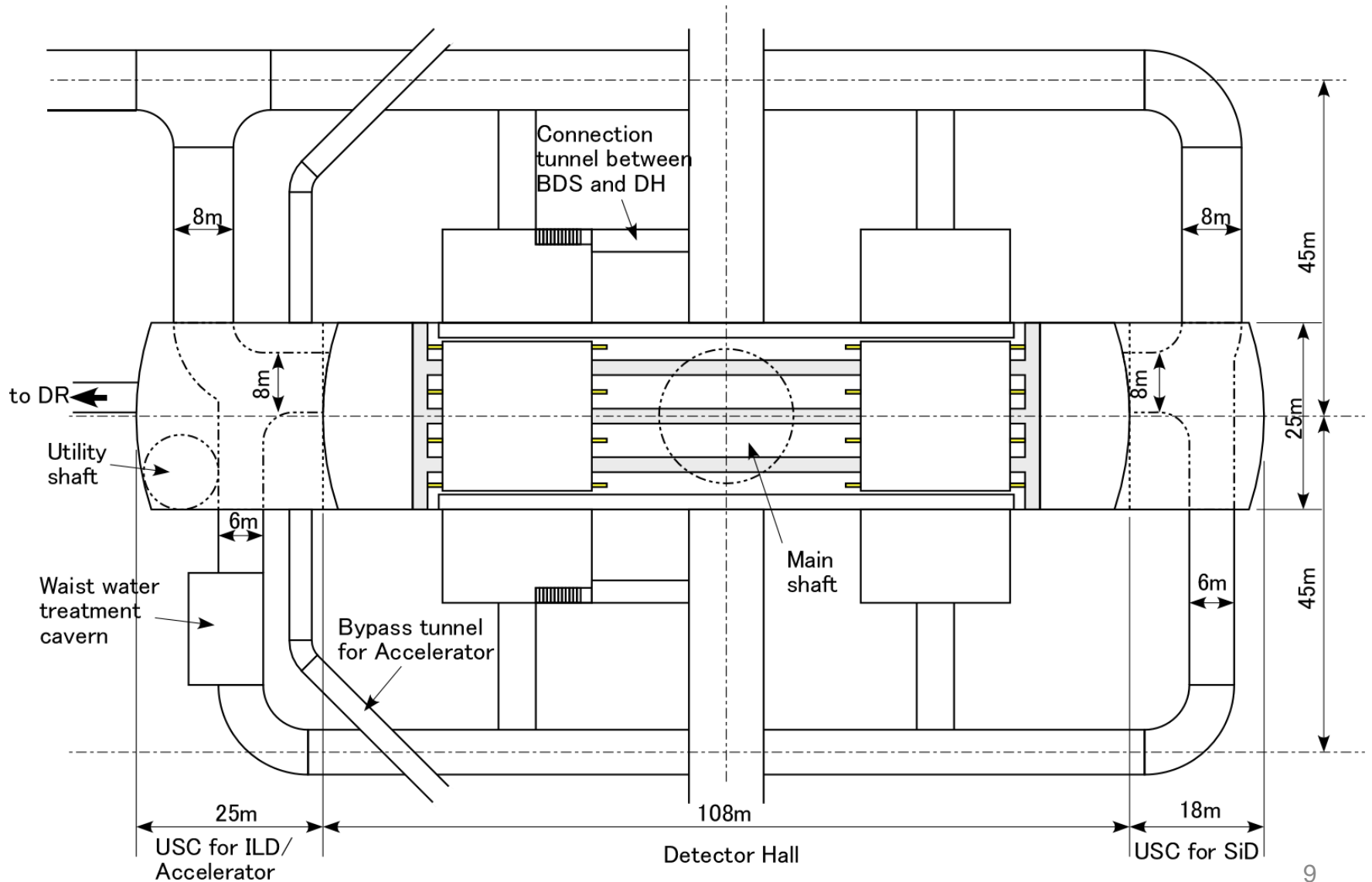


USC configuration

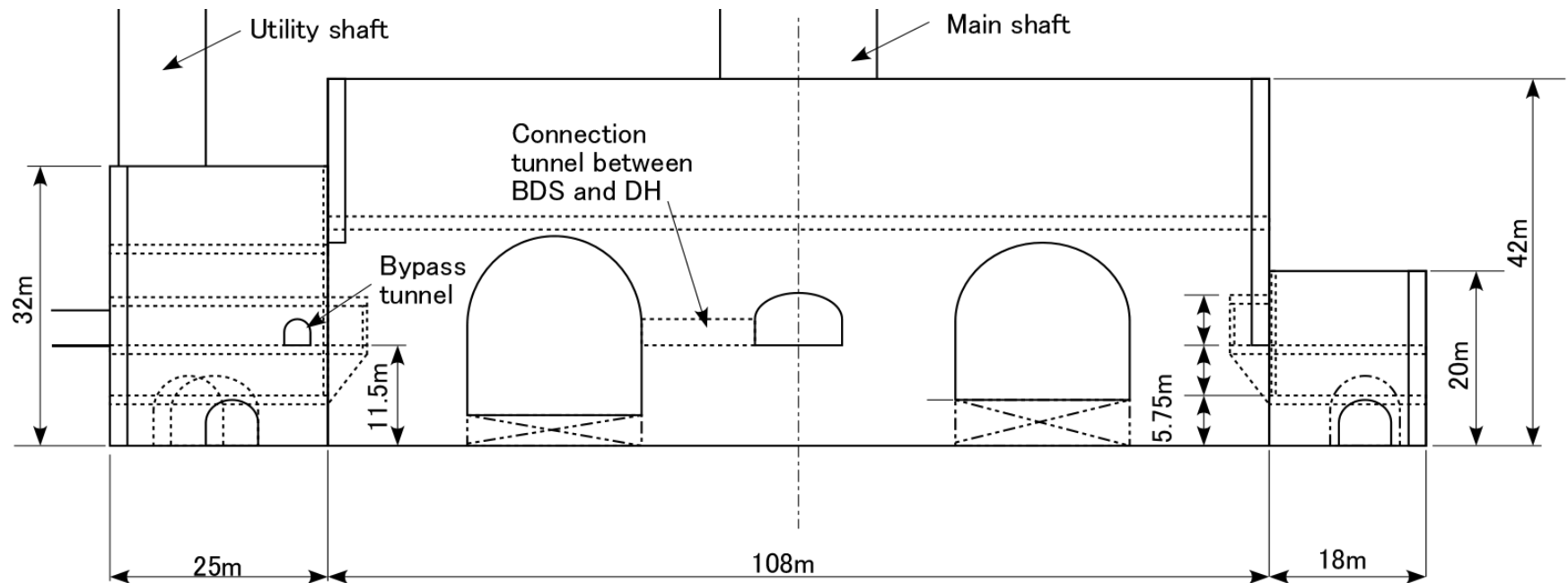
Tohoku design		Compromised design	
5F	HVAC	On surface	
4F	HVAC	5F	Cooling systems for ILD LASER system for ILD Workshop
3F	Cooling water for Acc.	4F	Cooling water for Acc.
2F	Transformer for Acc.	3F	Transformer for Acc. Transformer for ILD
1F	Helium cryogenics Water treatment	2F	Cooling systems for ILD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

Another cavern

Plane view

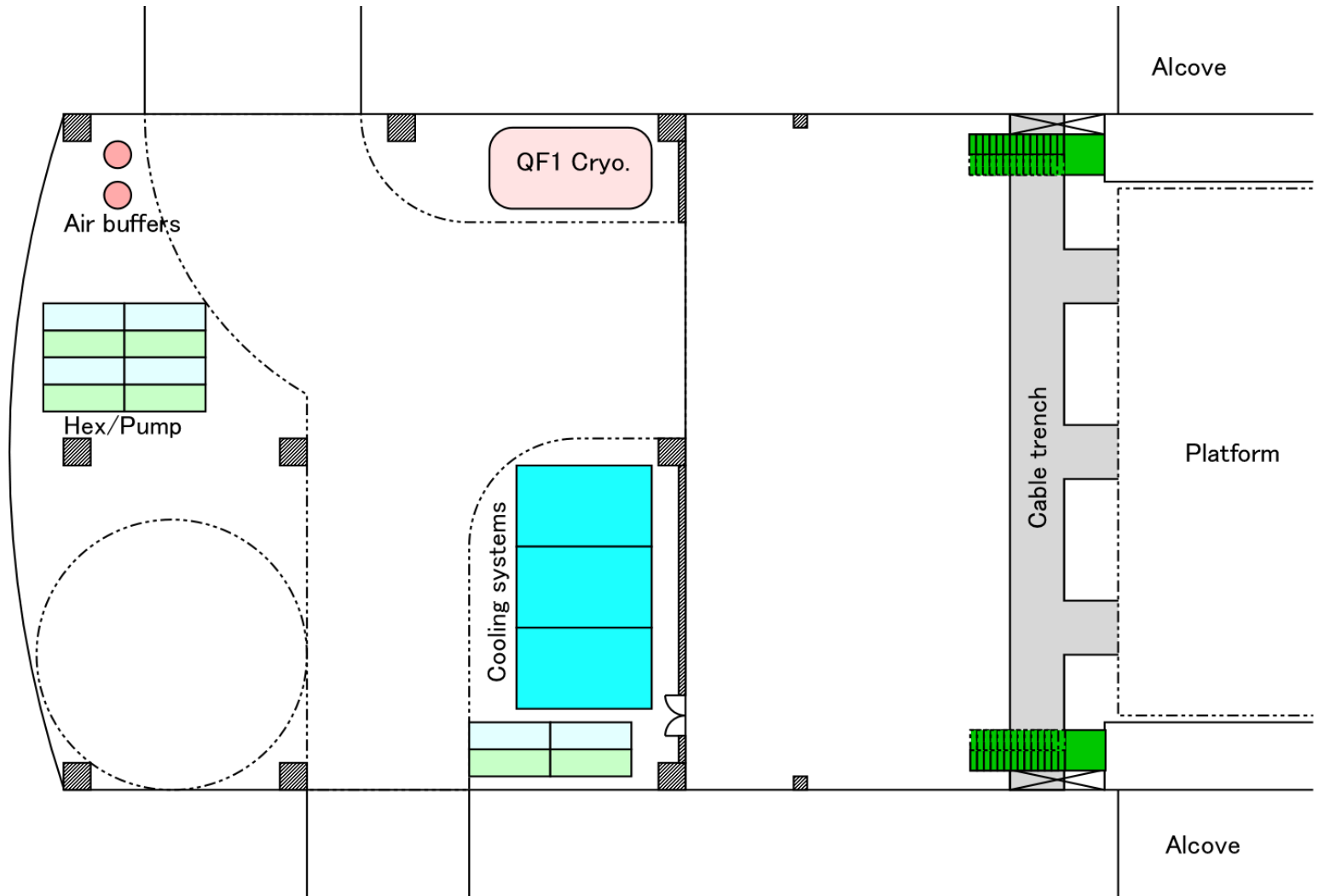


Side view



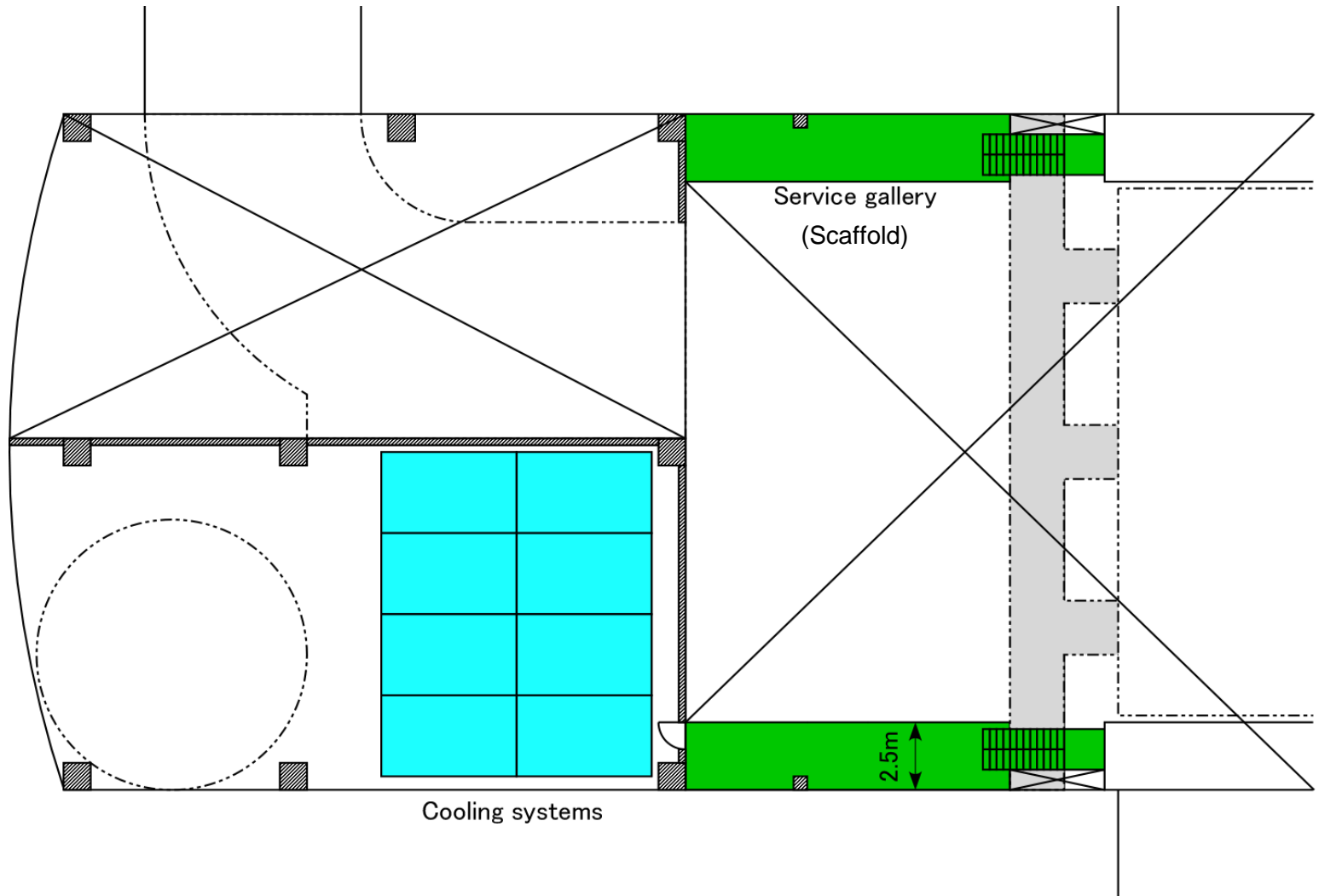
Utility space (ILD side)

- 1F



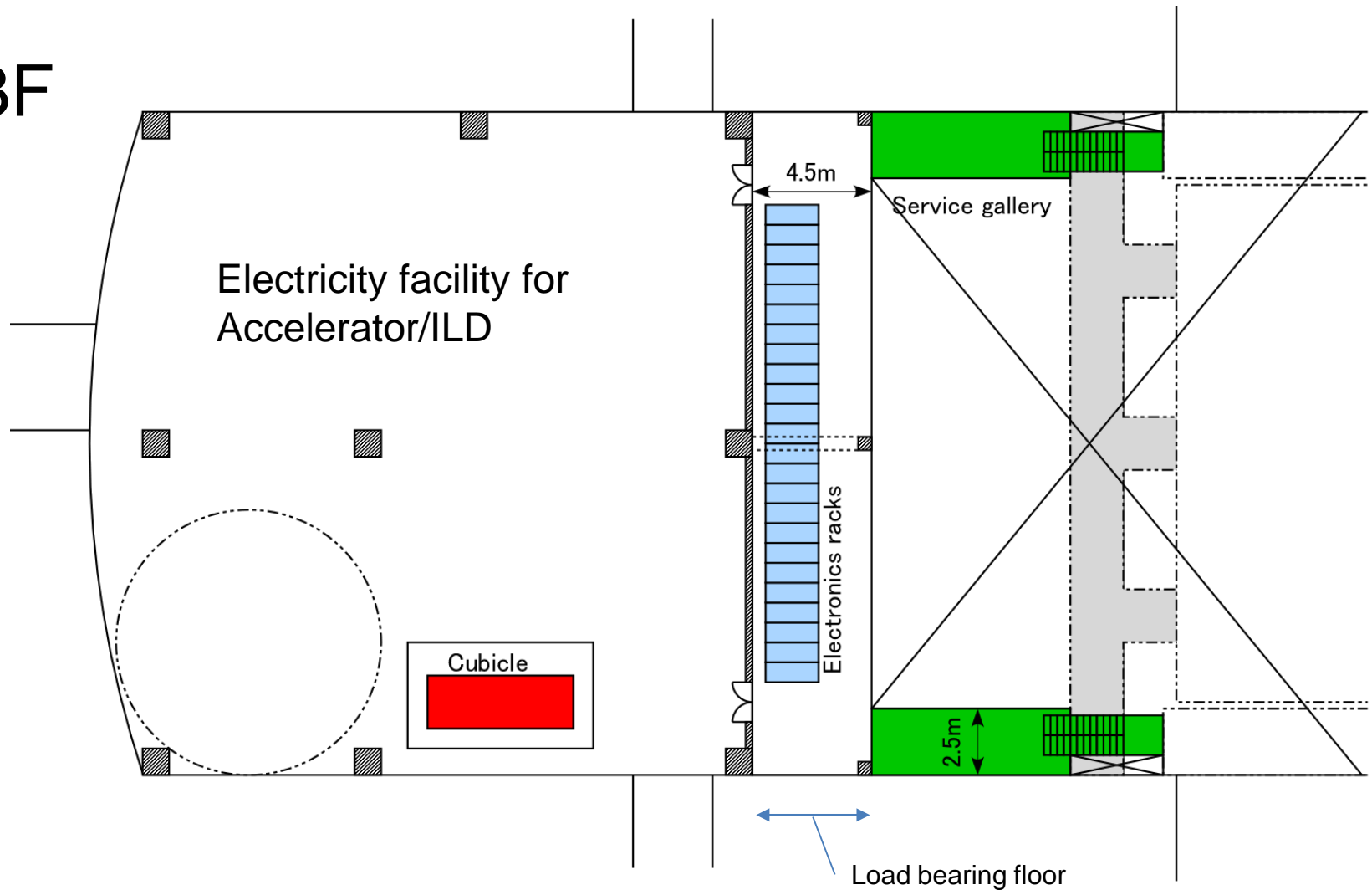
Utility space (ILD side)

- 2F



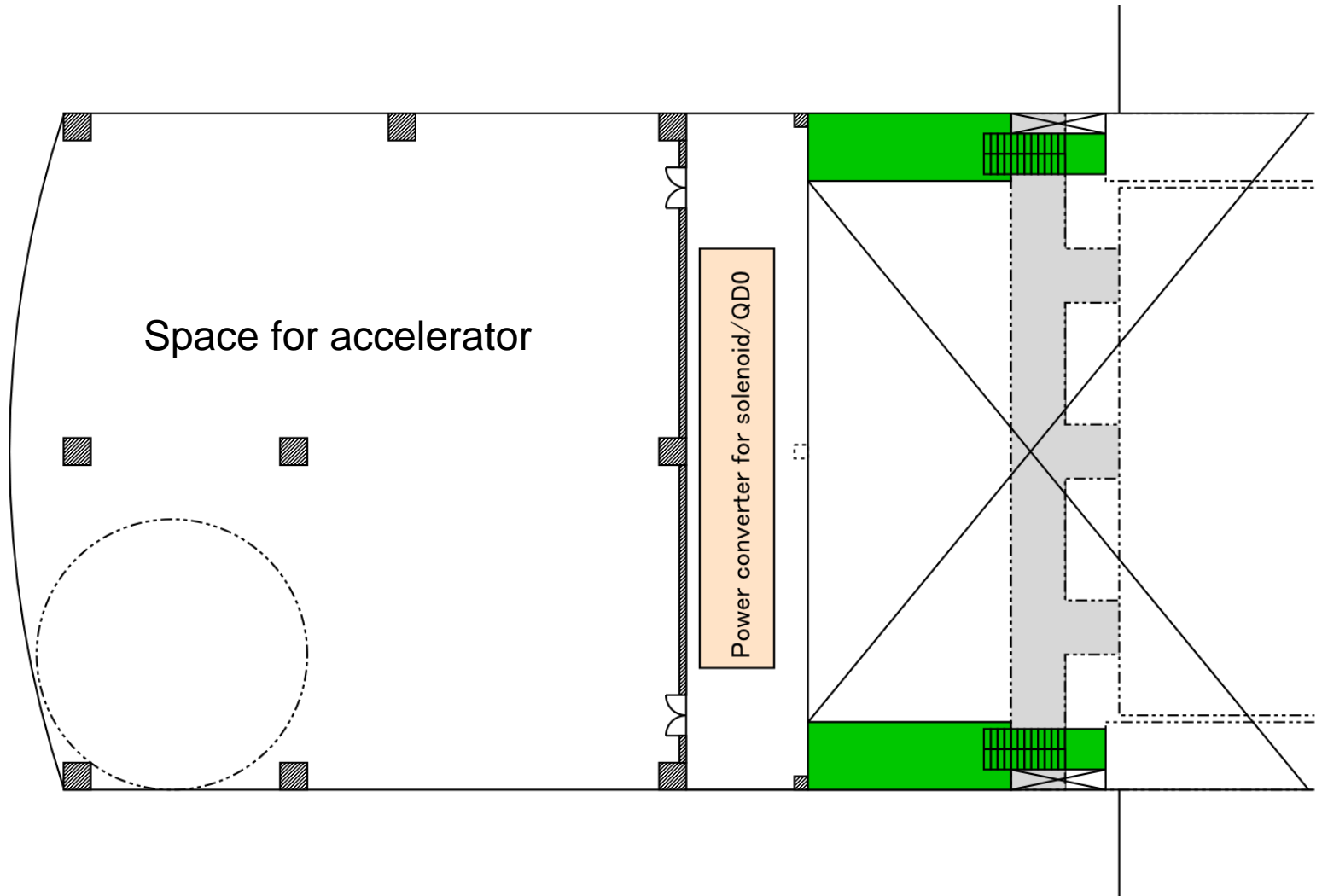
Utility space (ILD side)

- 3F



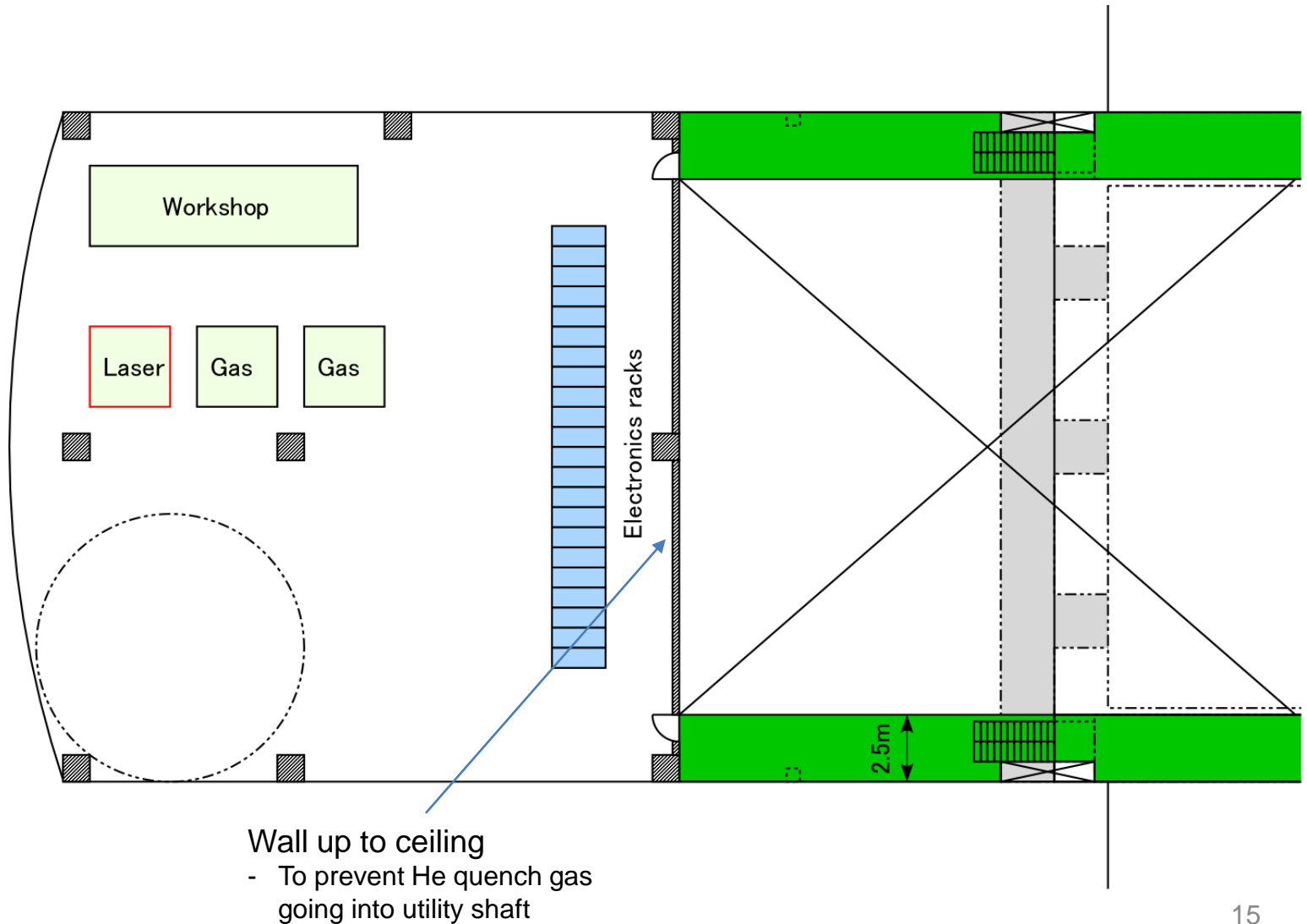
Utility space (ILD side)

- 4F



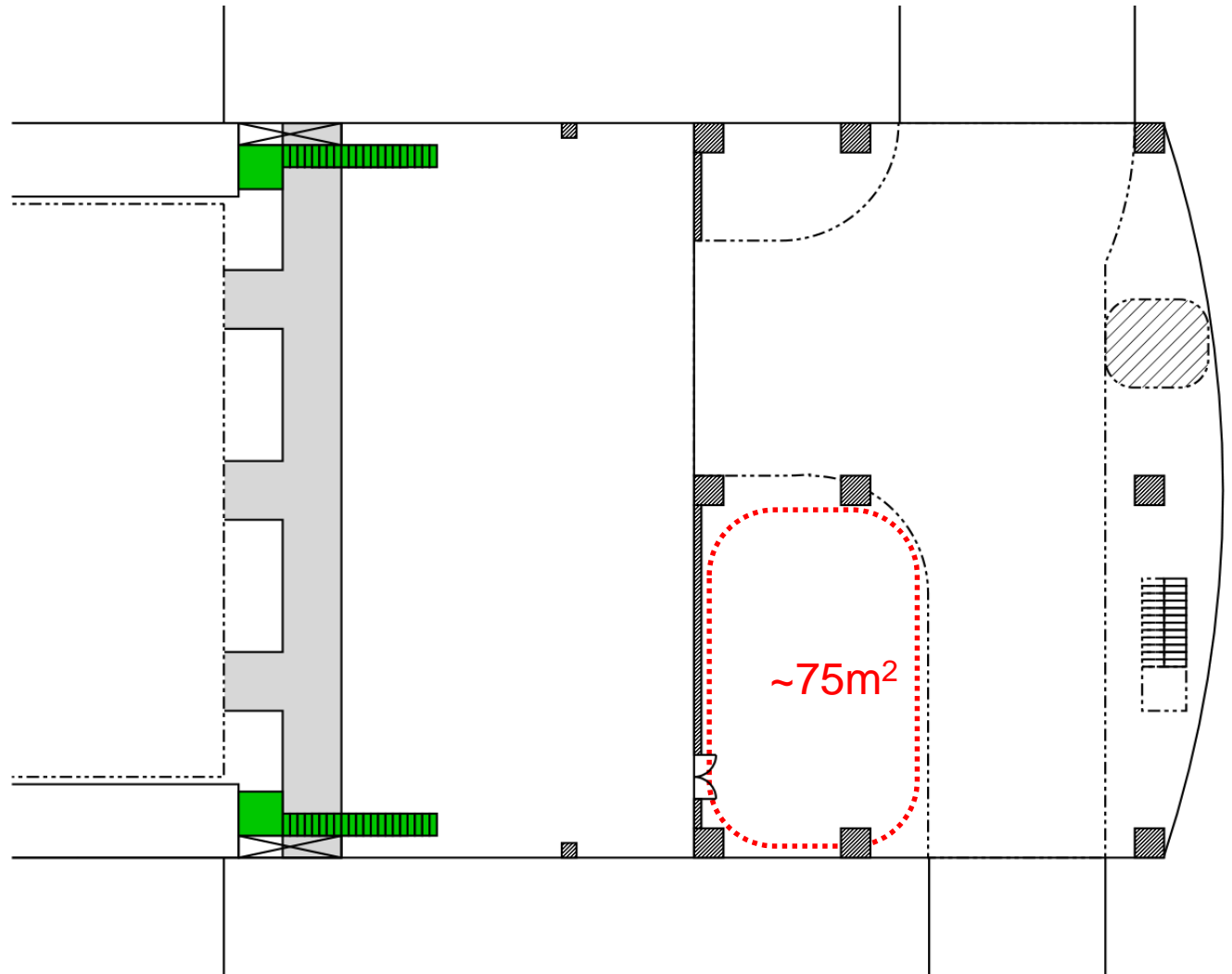
Utility space (ILD side)

- 5F



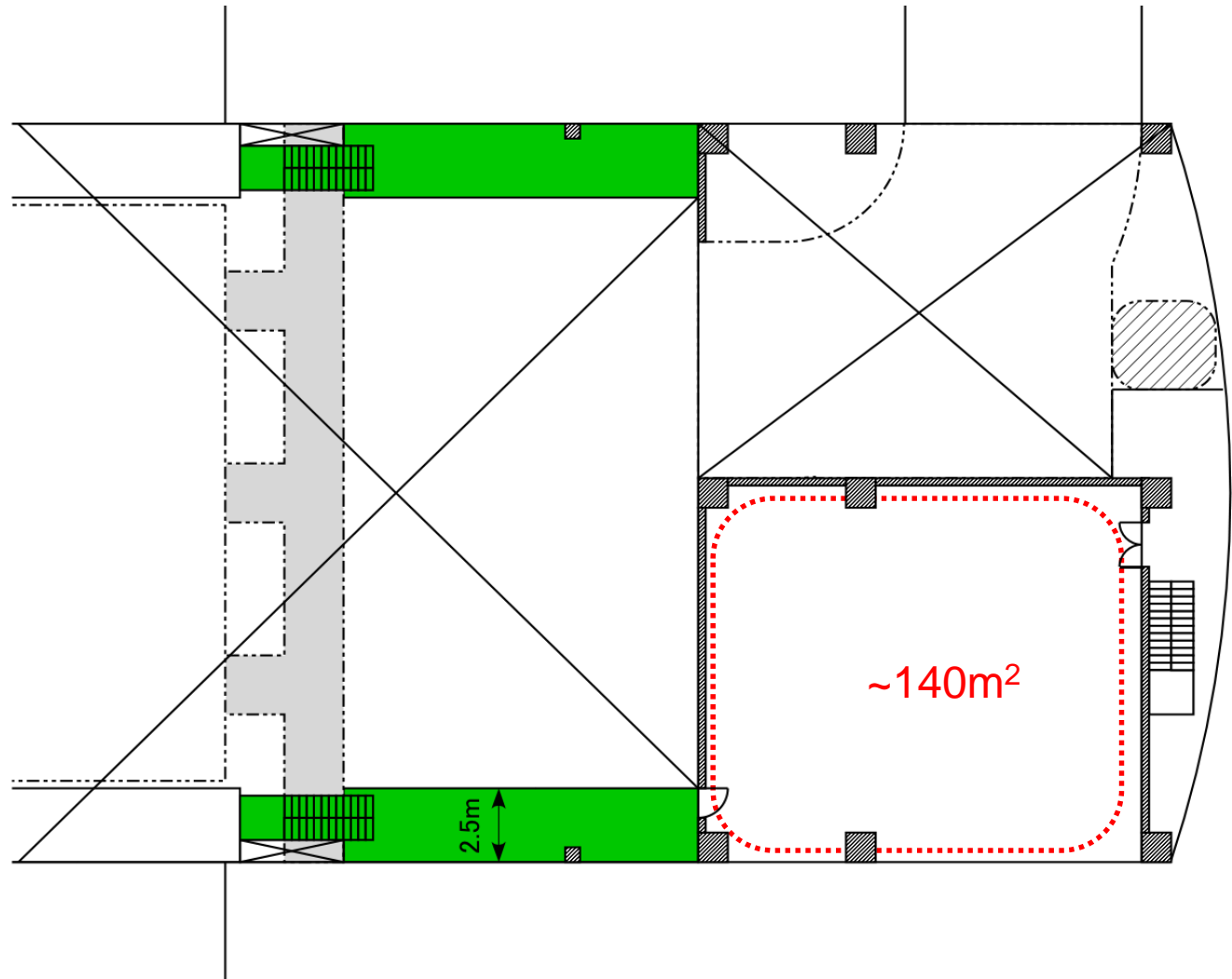
Utility space (SiD side)

- 1F



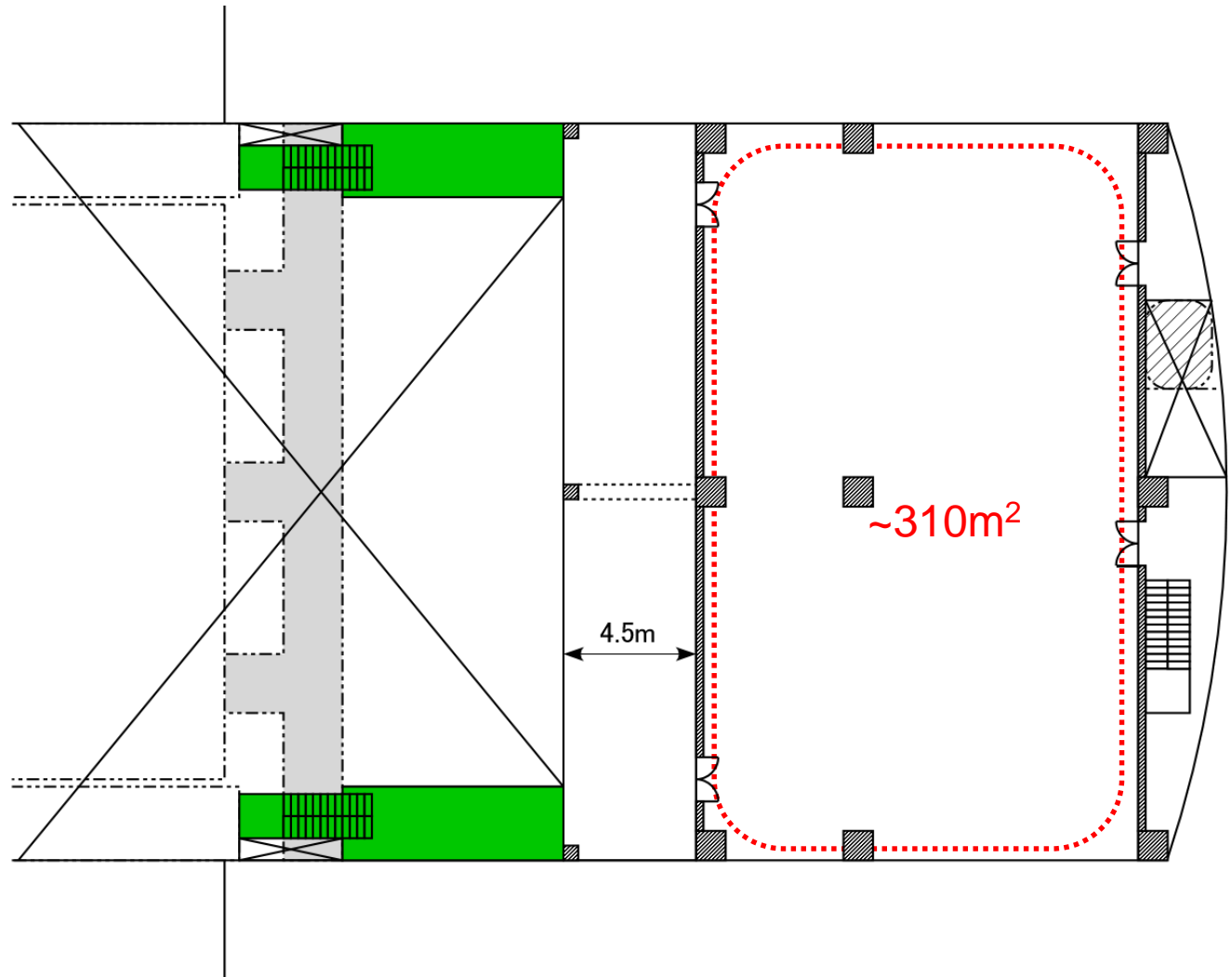
Utility space (SiD side)

- 2F



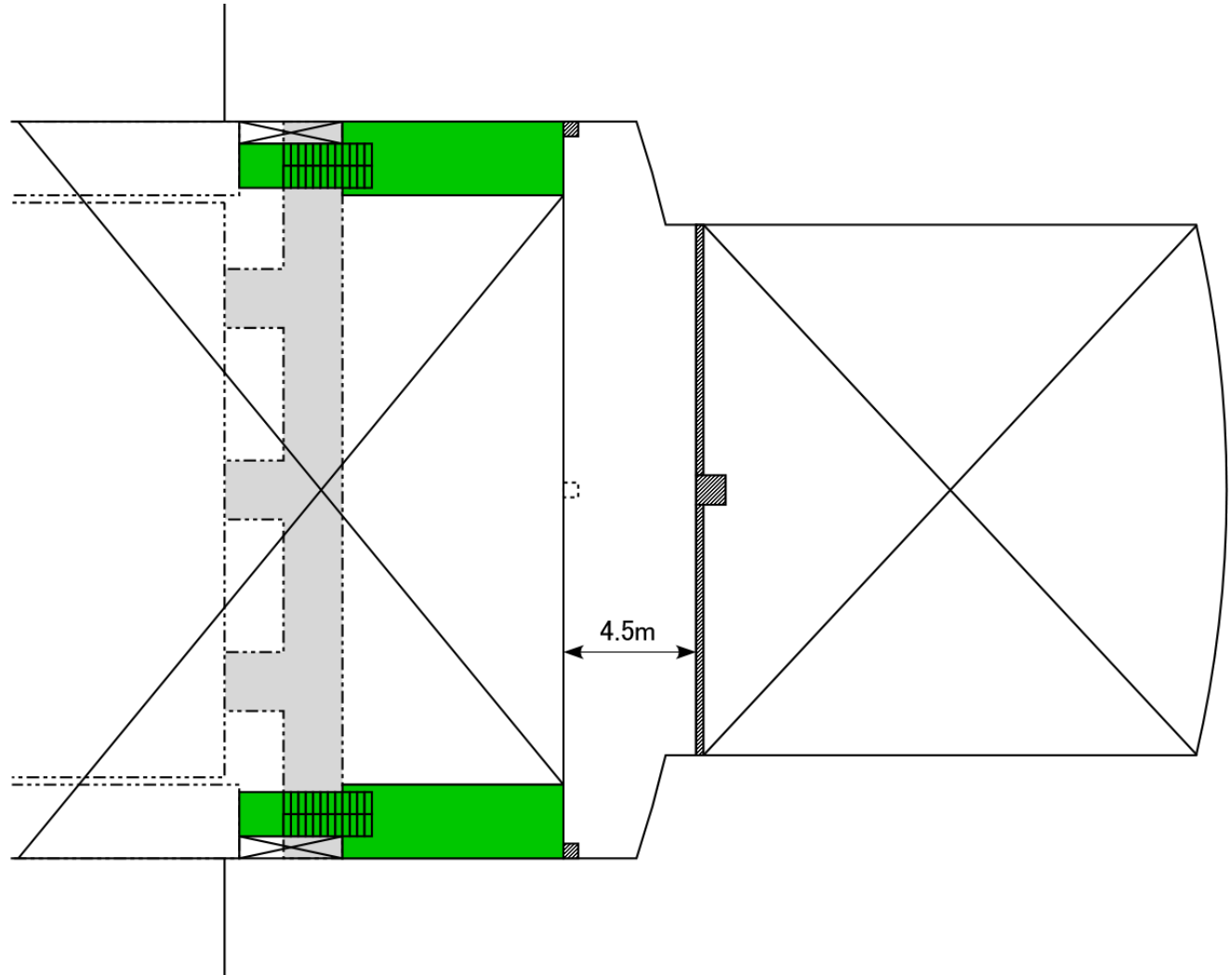
Utility space (SiD side)

- 3F



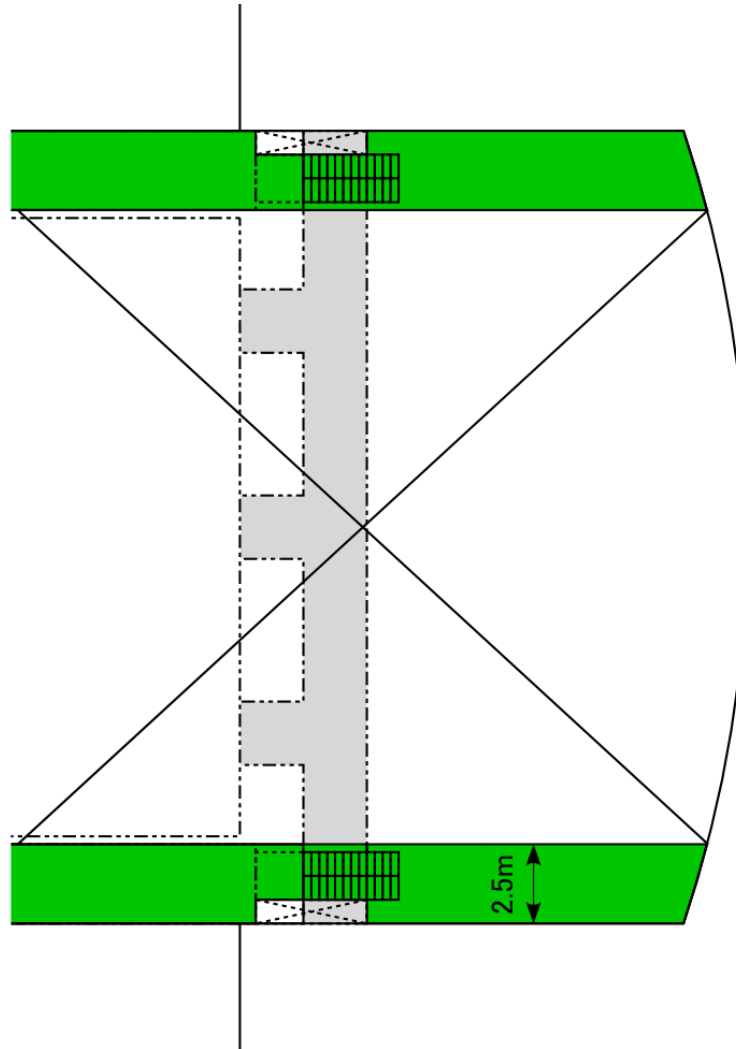
Utility space (SiD side)

- 4F

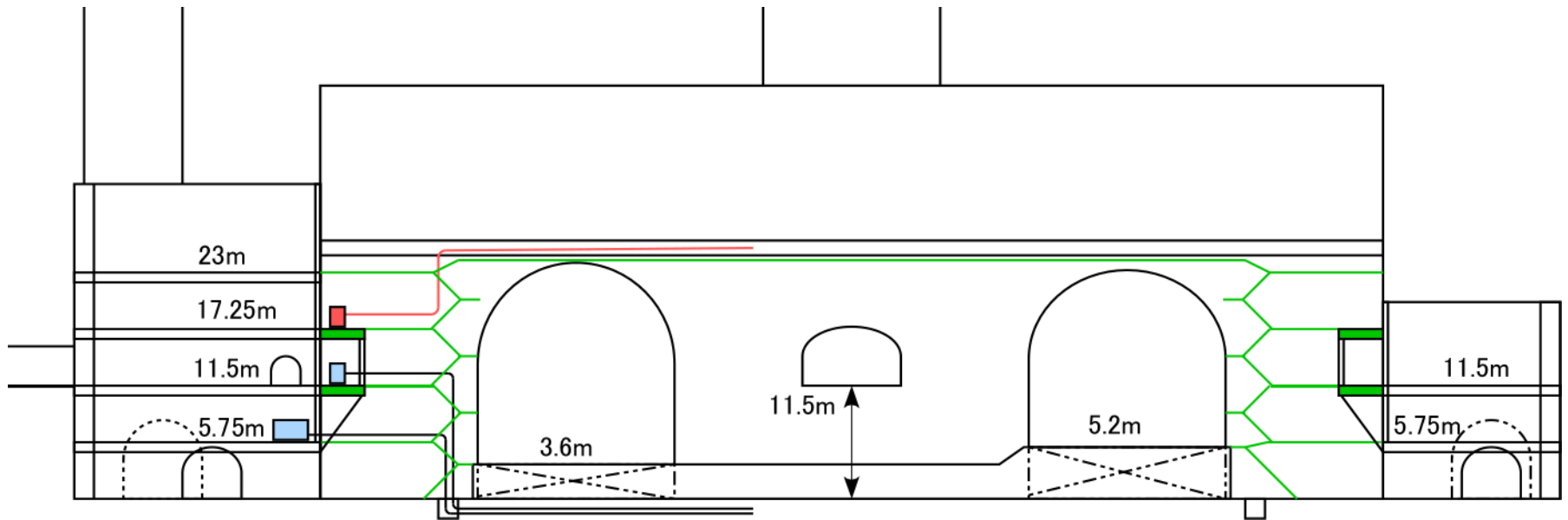


Utility space (SiD side)

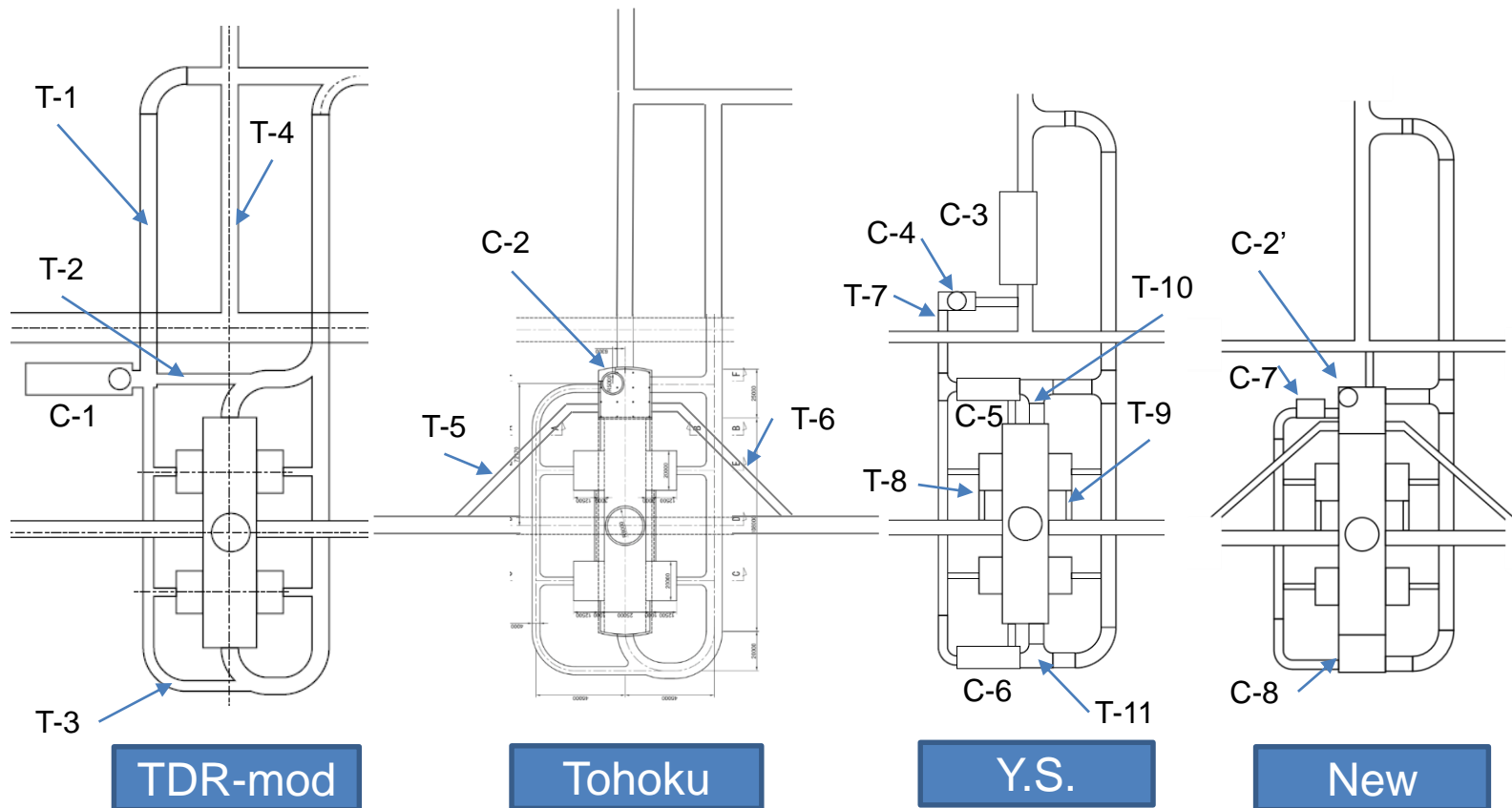
- 5F



Service gallery



Excavation volume

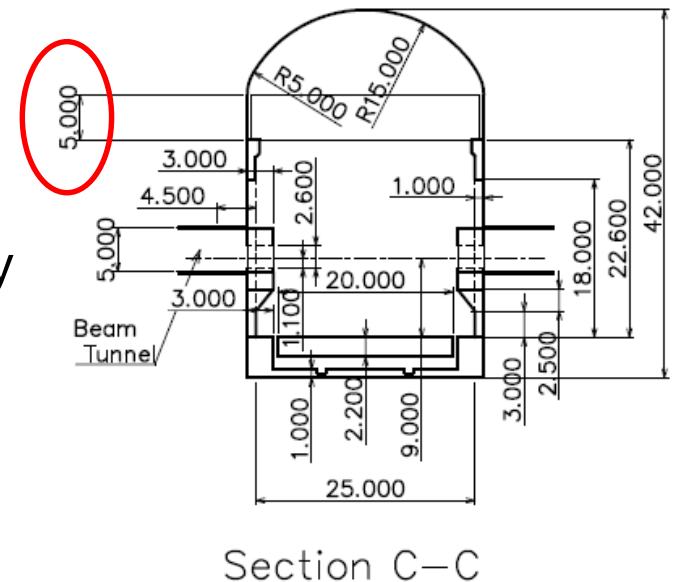


Excavation volume

	W (m)	H (m)	L (m)	V (m ³)	TDR-mod	Tohoku	Y.S.	New
T-1	8	7.5	170	10200	10200			
T-2	6	6	40	1440	1440	990		630
T-3	6	6	40	1440	1440	1440		990
T-4	8	7.5	45	2700	2700	2700		2700
T-5	4	4	60	960		960		960
T-6	4	4	60	960		960		960
T-7	6	6	40	1440			1440	
T-8	3	3	16	144			144	144
T-9	3	3	16	144			144	144
T10	8	8	25	1600	1600		1600	
T11	8	8	25	1600	1600	1600	1600	
C-1	15	12	50	9000	9000			
C-2	25	43	25	26875		26875		
C-2'	25	32	25	20000				20000
C-3	20	12	50	12000			12000	
C-4	10	8	20	1600			1600	
C-5	12	12	34	4896			4896	
C-6	12	12	34	4896			4896	
C-7	10	8	15	1200				1200
C-8	25	20	18	9000				9000
VS	-πx5x5x43			-3377		-3377		-3141
Sum					27980	32148	28320	33587
ΔV					0	4168	340	5607

DH height

- DH height(42m) has been determined before TDR
 - At that time, 250t crane existed in DH
 - 5m space above crane rail
- In recent design with vertical shaft, we use 40t crane in DH
 - 3m space above crane rail is necessary
- So, DH height could be 40m?
 - In that case, the excavation volume is reduced by $\sim 5400\text{m}^3 \rightarrow 28187\text{m}^3$,
 $\Delta V \sim 200\text{ m}^3$



TRANSPORTATION TO UG

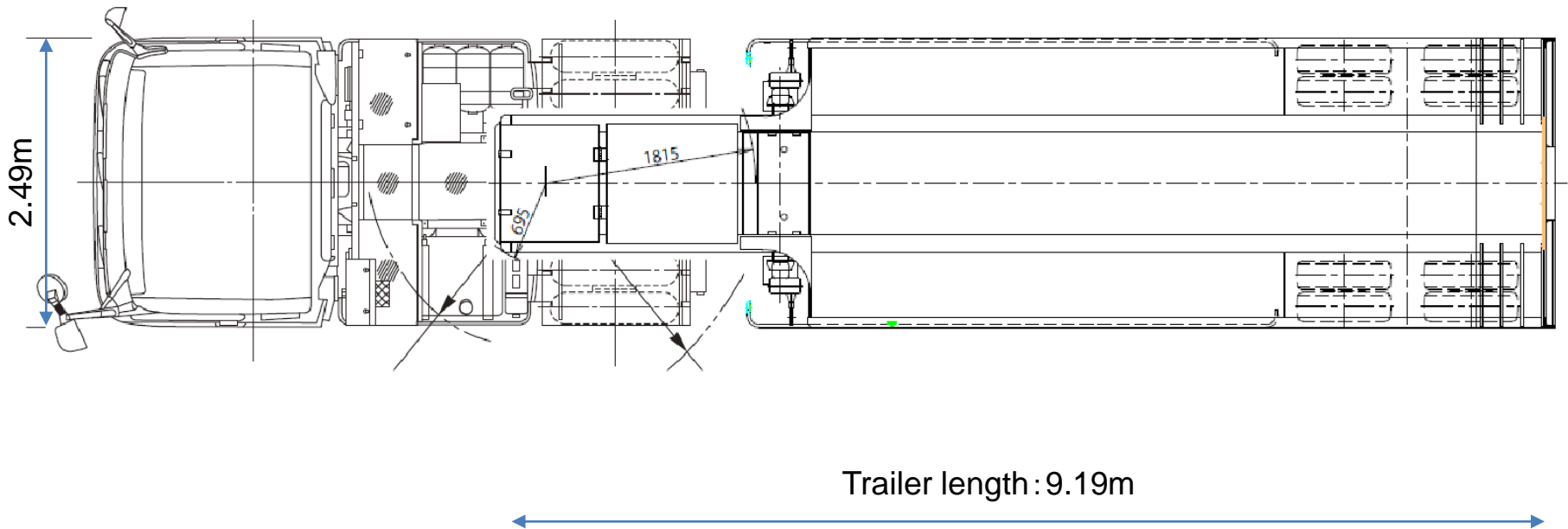
Transportation by trailer truck

- Sub-detectors which could be transported by trailer truck through Access Tunnel

	Weight	Size	Size with frame
Inner Support Tube	< 1t	~ 1m x 5m	~ 2m x 6m
TPC	~ 2t	3.6m x 4.7m	4.6m x 5.7m
Si tracker (SiD)	?	2.4m x 3m	3.5m x 4m
ECAL stave	10t + α		1.5m x 5m
AHCAL module	20t + α		1.1m x 2.2m
QD0 pillar	?	~1m x 8.5m	

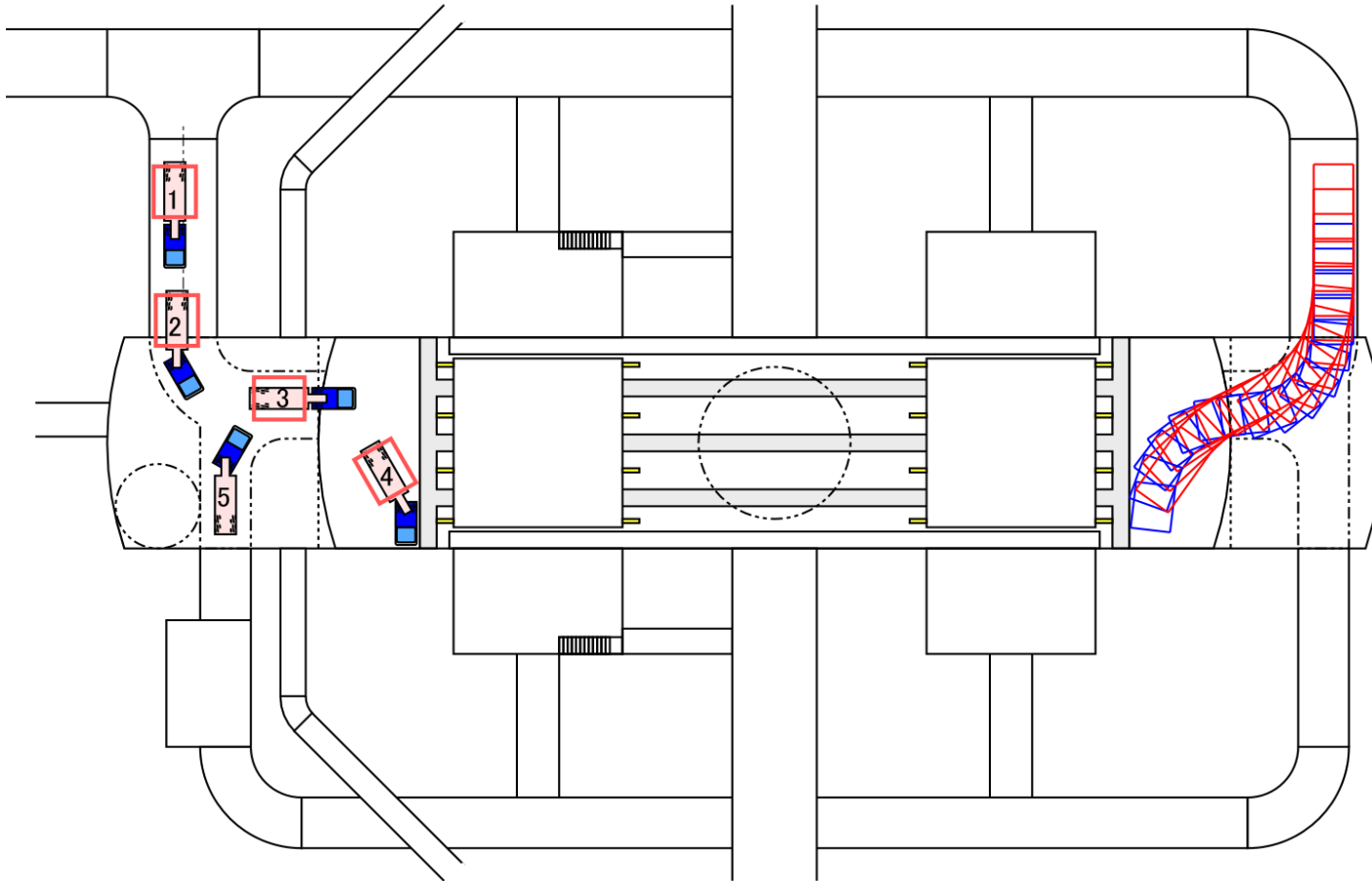
Transportation by trailer truck

- Trailer truck considered:
 - Tractor: Mitsubishi Fuso • FP64VDR4XCV
 - Trailer: TL26G4E2



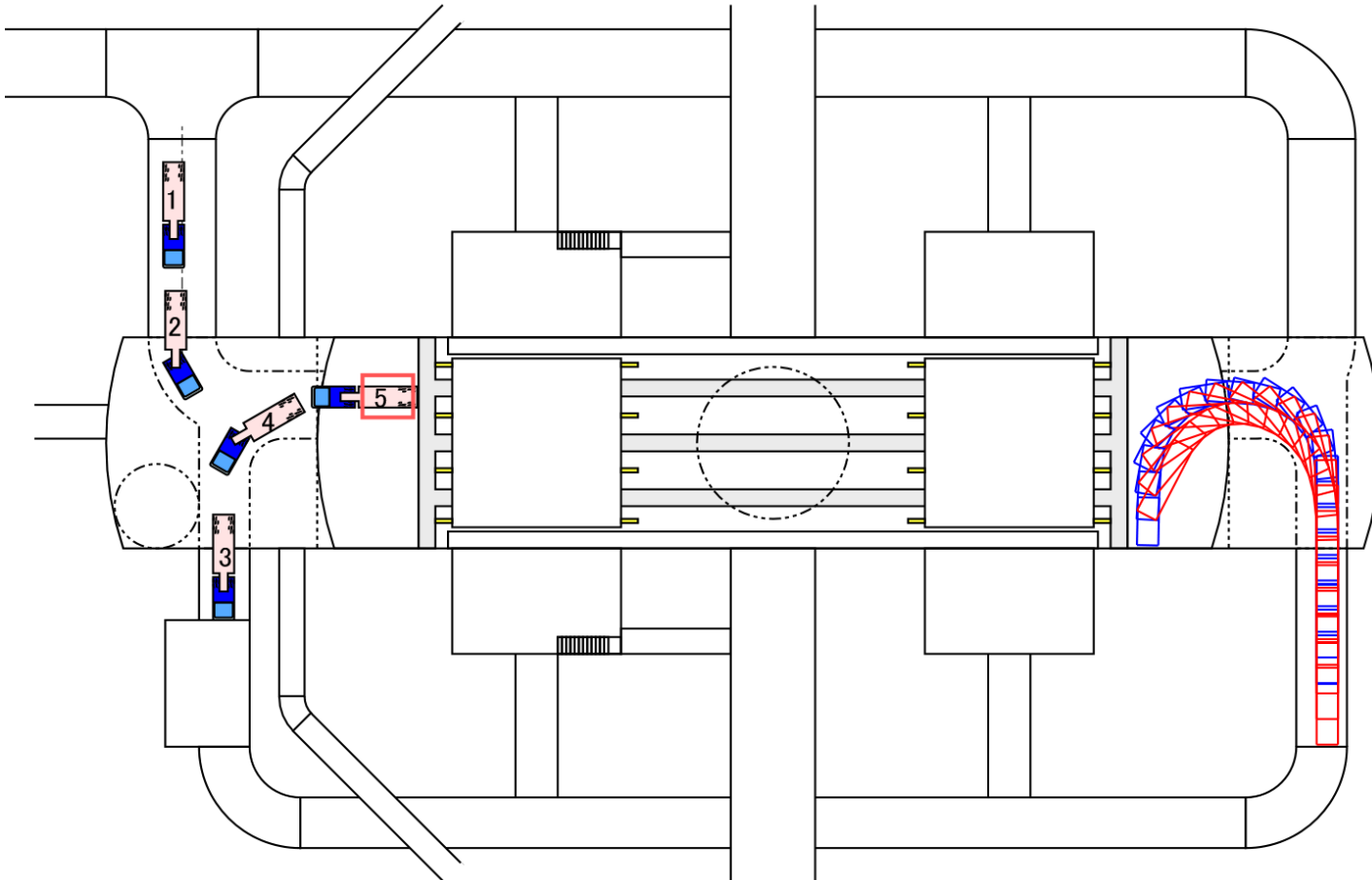
Carry in to DH

- Go forward to DH (position 4)
- After unloading, go back to 6m passage (position 5), then go forward to surface



Take out from DH

- Go forward to 6m passage (position 3), then go back to DH (position 5)
- After loading, go forward to surface

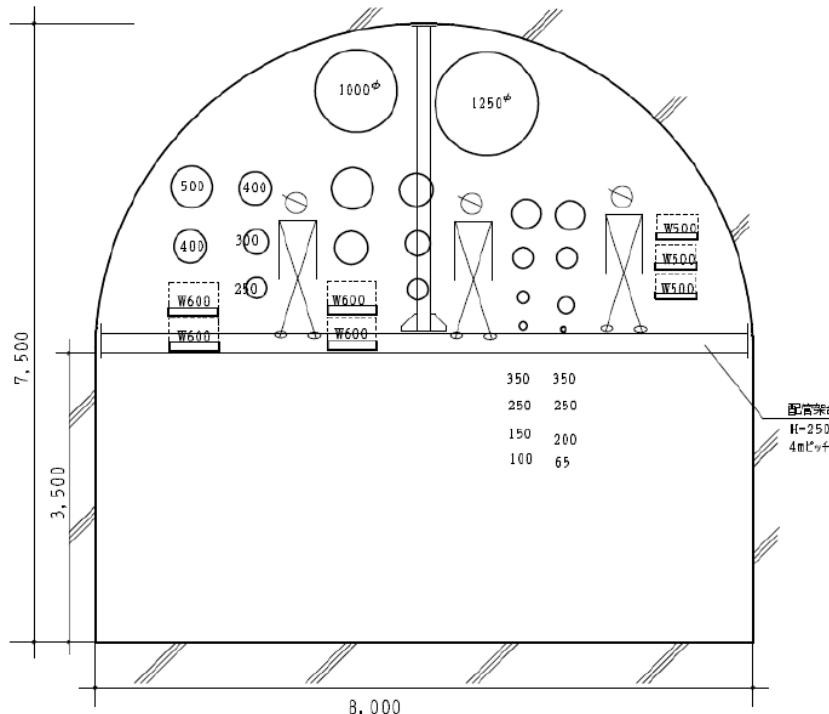


Access tunnel

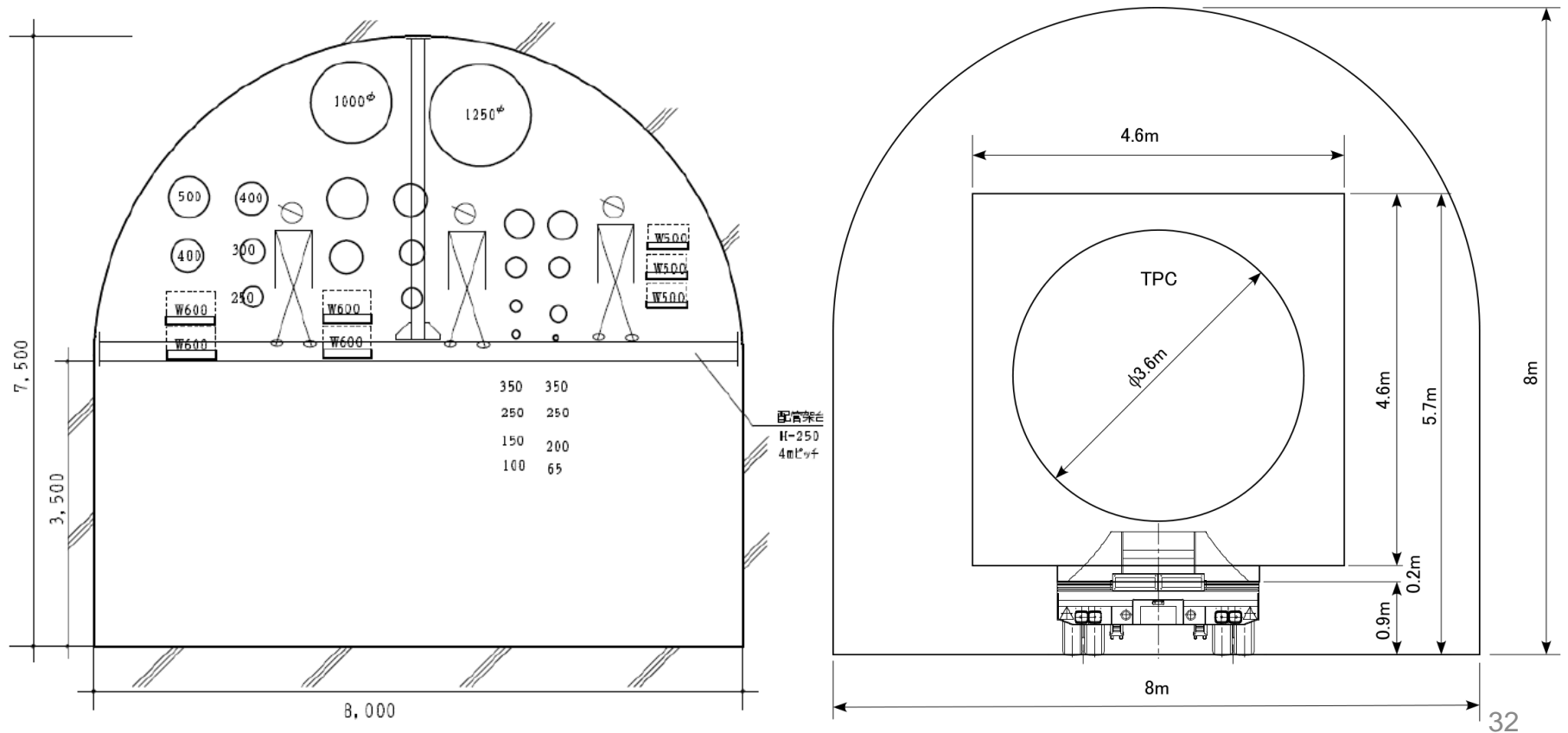
Proposal of pipes(He, Water and air), power cables arrangement in the access tunnel

This figure shows only the required space in access tunnel for cable and rack

This is not the actual installation plan



Access tunnel



Access tunnel

- We need more investigation
 - Enlarge common part for Acc. And Det.?
 - Combine Helium system to Utility Shaft?

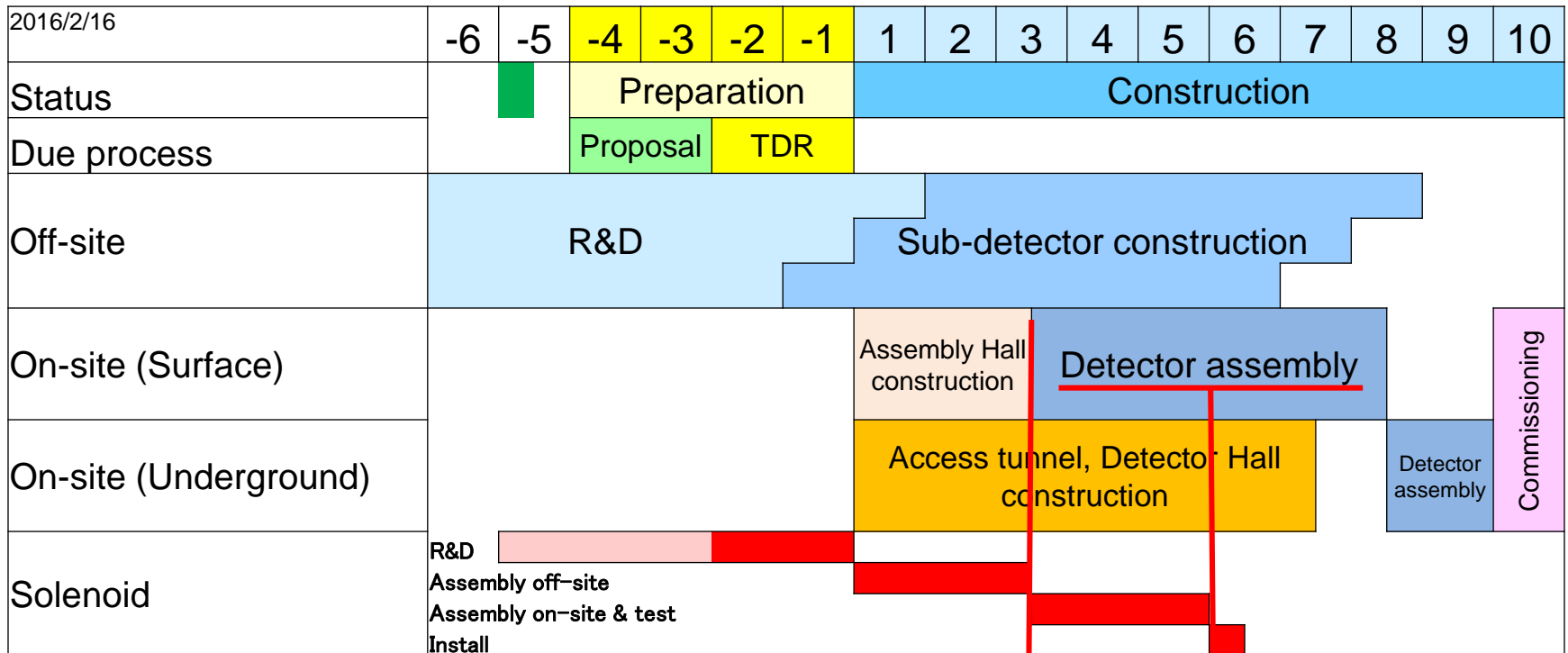
Transportation to USC

- Heaviest equipment to be transported
 - 300 kVA Transformer unit (cubicle): 1.3 t (h=2.2m)
 - To be transported by elevator
 - The elevator with capacity of 2 ton and height of the door of 2.5m would be OK
- Weight of the solenoid power supply is not clear yet, but it can be placed to the 4th floor service gallery from DH side using a crawler crane
- More consideration is necessary for SiD side

UTILITY REQUIREMENTS DURING CONSTRUCTION PERIOD

Expected Schedule


NEC facility available (15y?)



This schedule
could be delayed

Electricity could be limited @IR

Utility during construction period

- New high voltage (154kV) electricity line (~15km) has to be build to IP campus (Tohoku team's study)
 - Cabling in ML will be finished after Y8 (TDR)
 - Cooling water will be supplied from north end of ML (Tohoku team's study), and piping in ML will be completed at the end of Y7 (TDR)
- 
- Utility at IP campus will be fully available after Y8, and limited during construction period
 - We have to investigate
 - available utility (electricity/water) at present
 - utility requirements (peak & average) during the detector construction period at IP campus
 - schedule of HV electricity power line construction to IP campus
 - If necessary, we should think about complementary power source (Solar power system?)
 - Utilization of pre-campus close to Ichinoseki station is an option in order to reduce utility requirement at IP during construction period

SUMMARY

Summary

- A new design of USC combined with DH has been presented
 - ILD/Accelerator side: W25m x L25m x H32m
 - SiD side: W25m x L18m x H20m
- In this design
 - Floor area for SiD > 500m²
 - No problem for transportation with 12m long trailer truck
 - If DH height is reduced to 40m, the excavation volume is similar to that of TDR-mod design
- More discussion on USC is necessary
 - Requirements from SiD
 - Cavern shape optimization (consultation with construction companies)
 - Design of the access tunnel
- Elevator in the Utility Shaft should have capability of carrying “cubicles” (2 ton capacity and 2.5m door height)
- Utility requirement at IP campus during detector assembly period should be clarified

BACKUP SLIDES

