Requirements from ILD

Karsten Buesser

Mini-Workshop on ILC Infrastructure and CFS for Physics and Detectors
16.05.2017

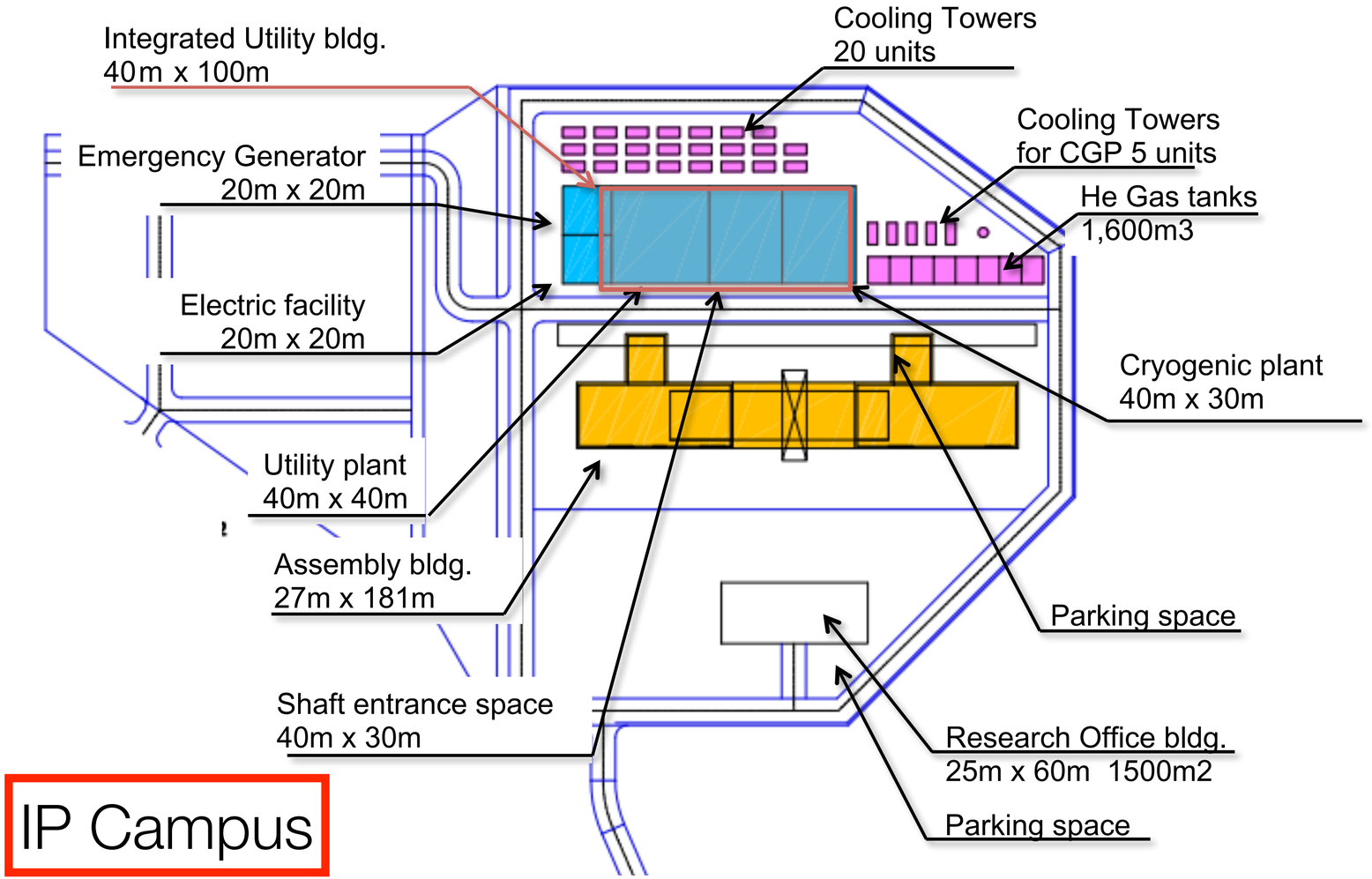
E-JADE is a Marie Sklodowska-Curie Research and Innovation Staff Exchange (RISE) action, funded by the EU under Horizon2020

IP Campus Planning

Slide from Yoshinobu Nishimoto

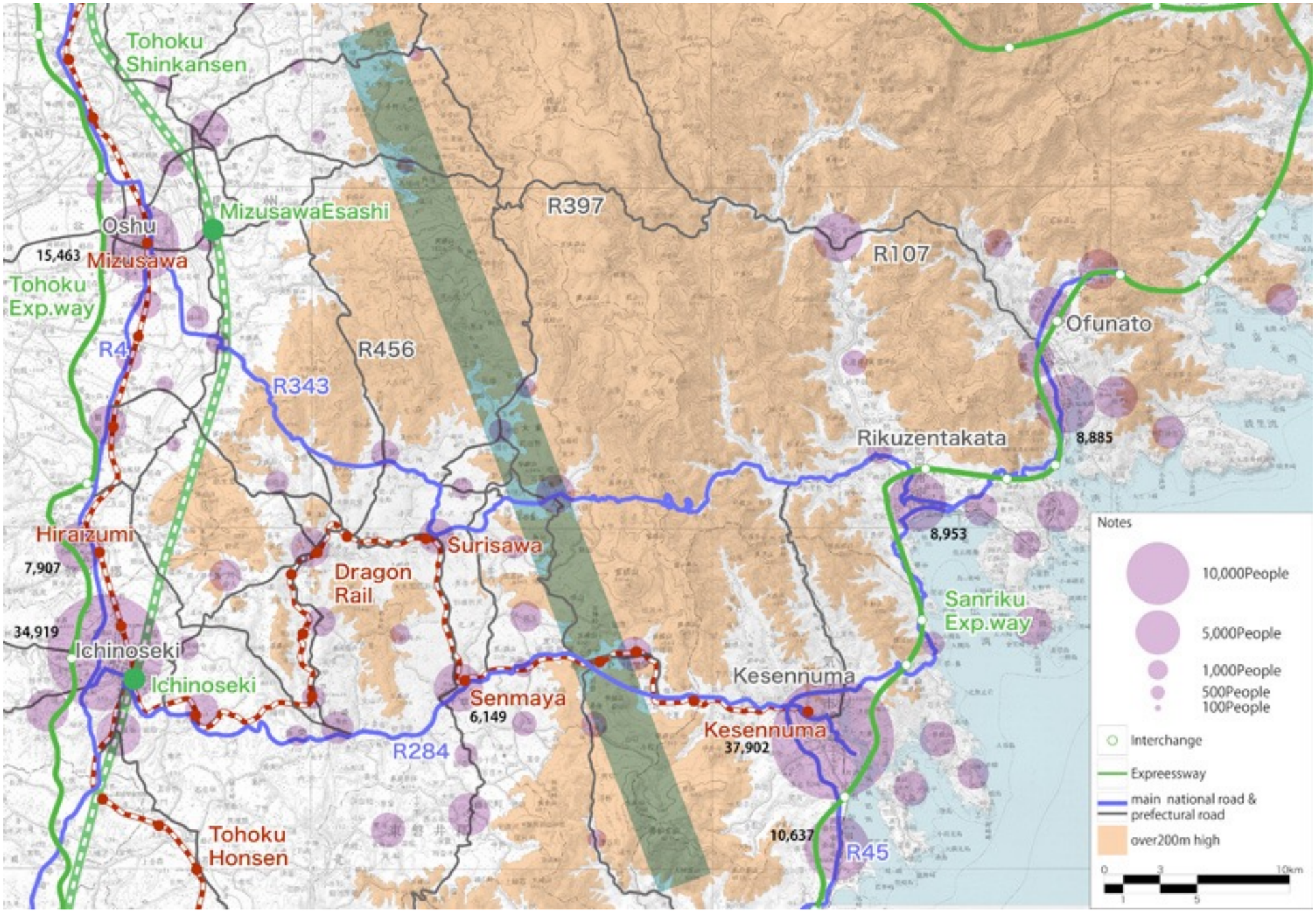
Surface ground Buildings and facilities

- Need to know more about the new proposed IP site
- NDA between KEK and DESY is being negotiated right now
- Hope to have it soon



KITAKAMI Site: Transportation

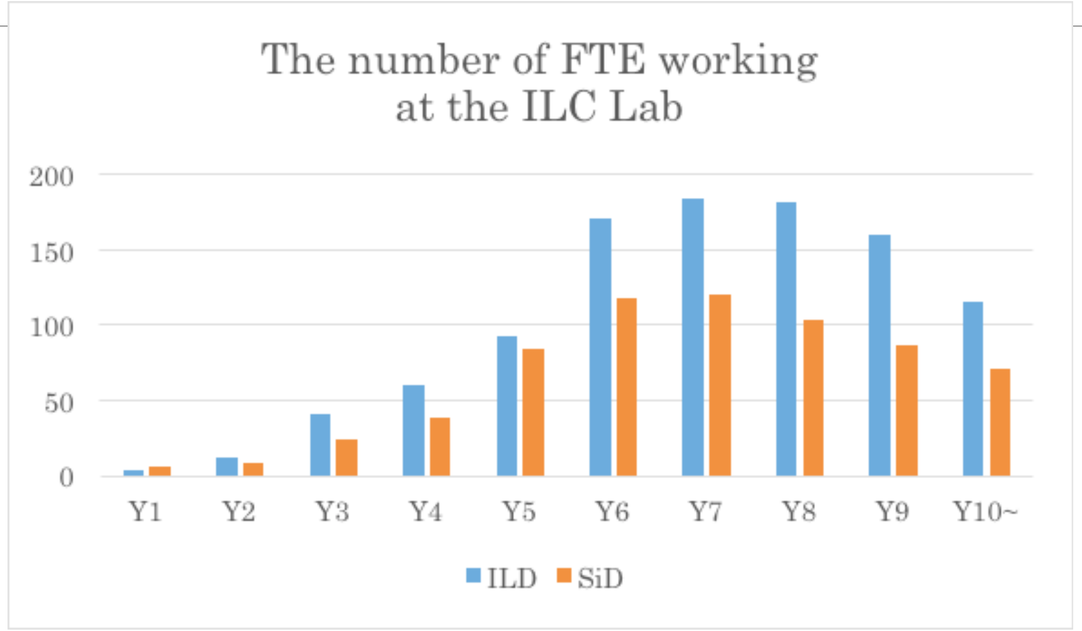
Slide from Tokiko Onuki

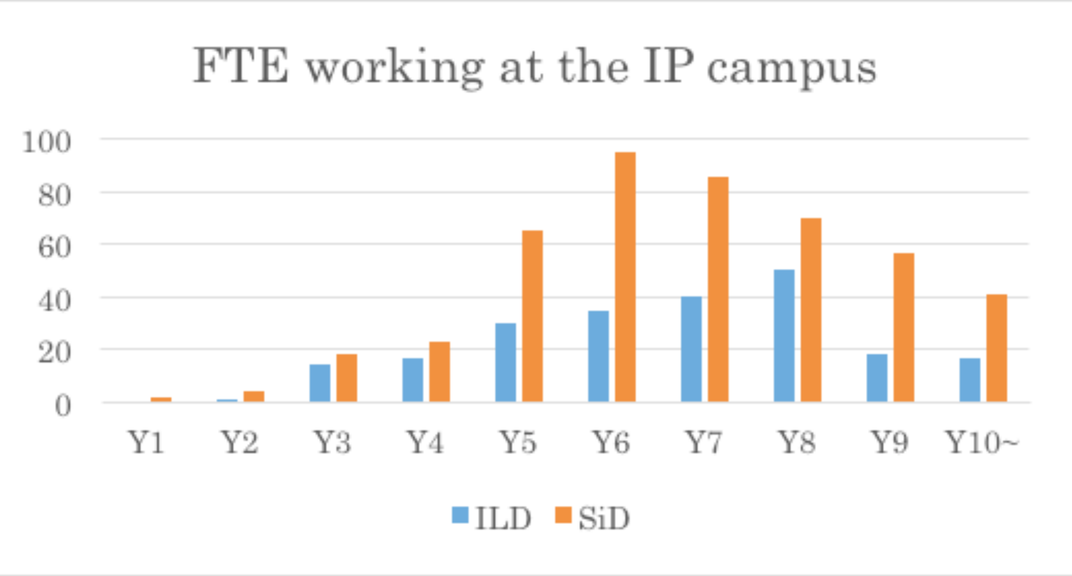


Manpower at IP Campus

- 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

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

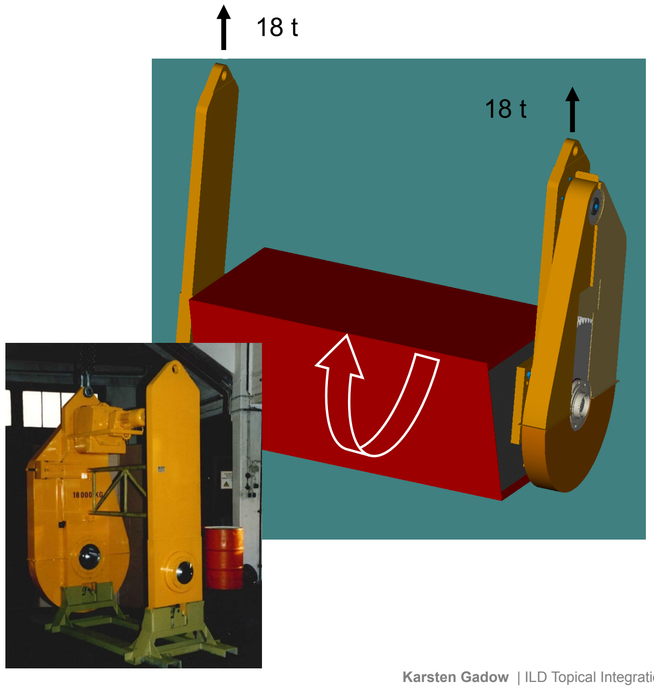
GEWICHT		
Tara	kg	2700
	pd	5950
Max. Zuladung	kg	27780
	pd	61250
Max. Bruttogewicht	kg	30480
	pd	67200

the container fits to standard transport systems

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

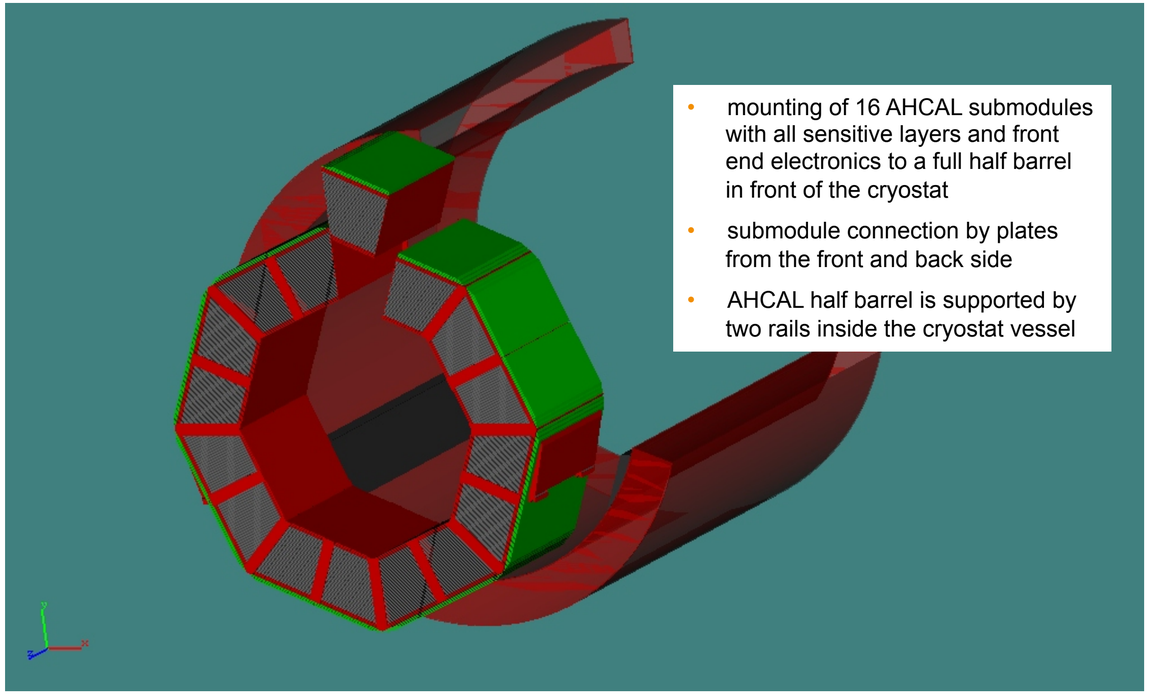
Slide from Karsten Gadow

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



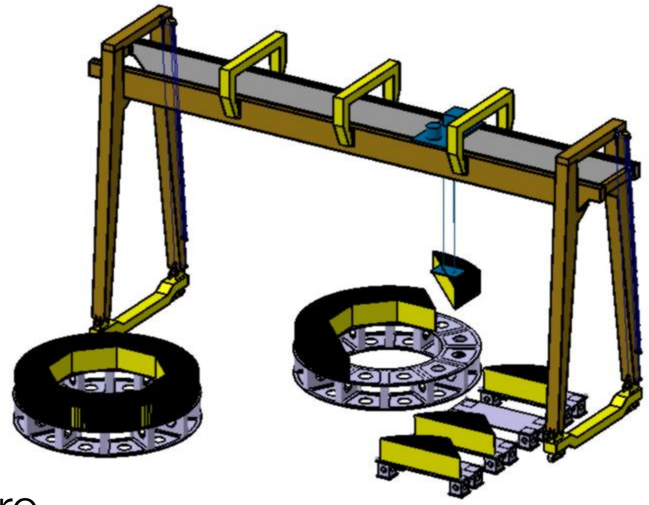
- mounting of 16 AHCAL submodules with all sensitive layers and front end electronics to a full half barrel in front of the cryostat
- submodule connection by plates from the front and back side
- AHCAL half barrel is supported by two rails inside the cryostat vessel

Slides from Karsten Gadow

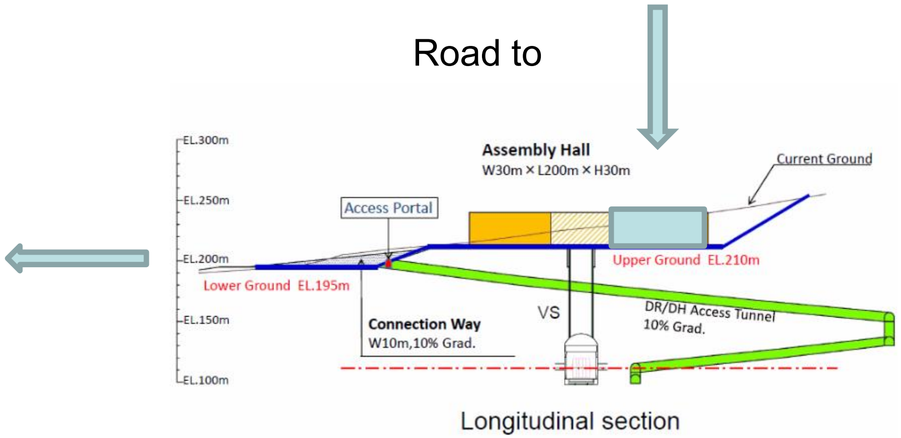
- Wheel Building in **Assembly Hall** : 8 modules x 5

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



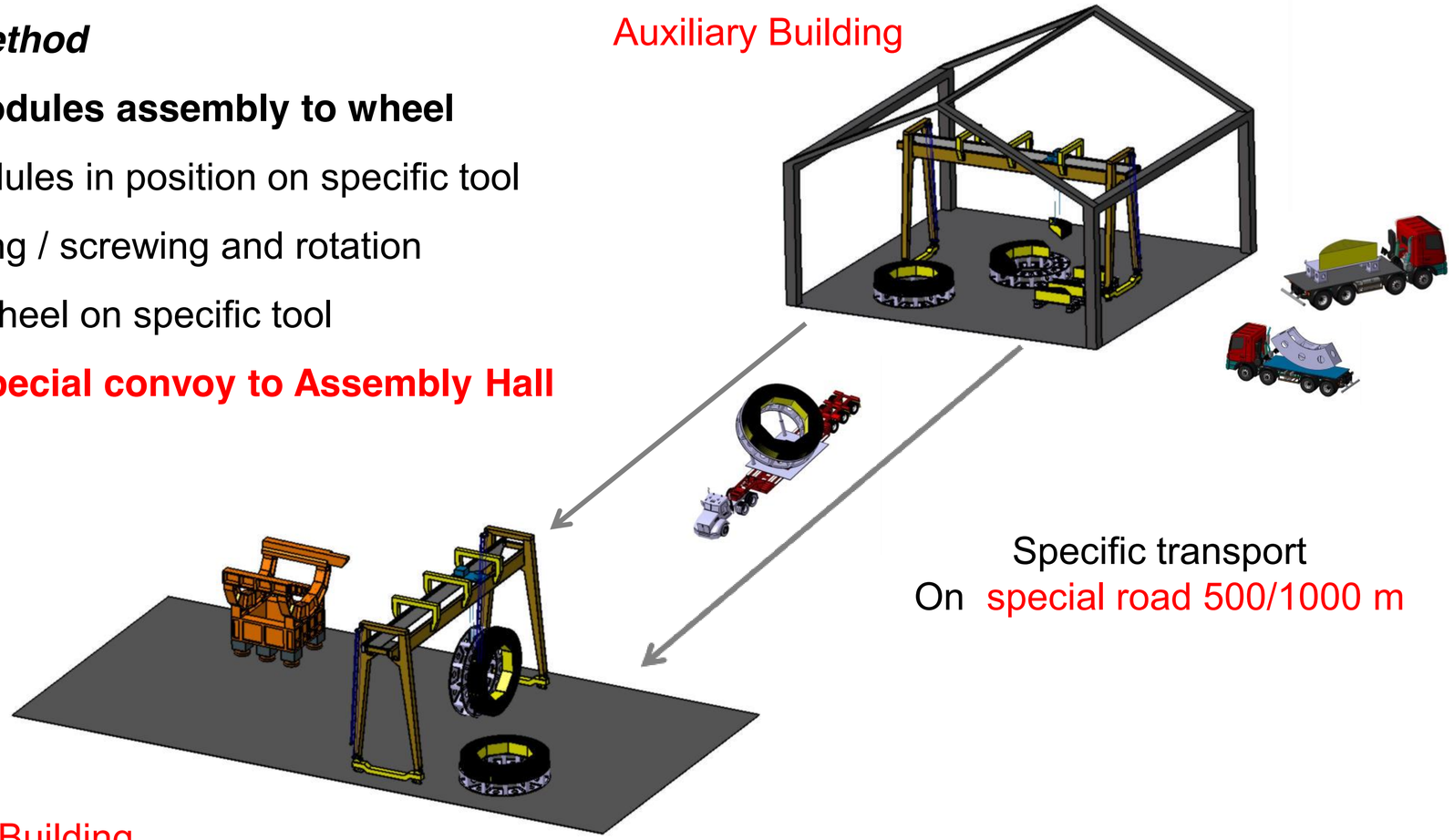
Longitudinal section

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

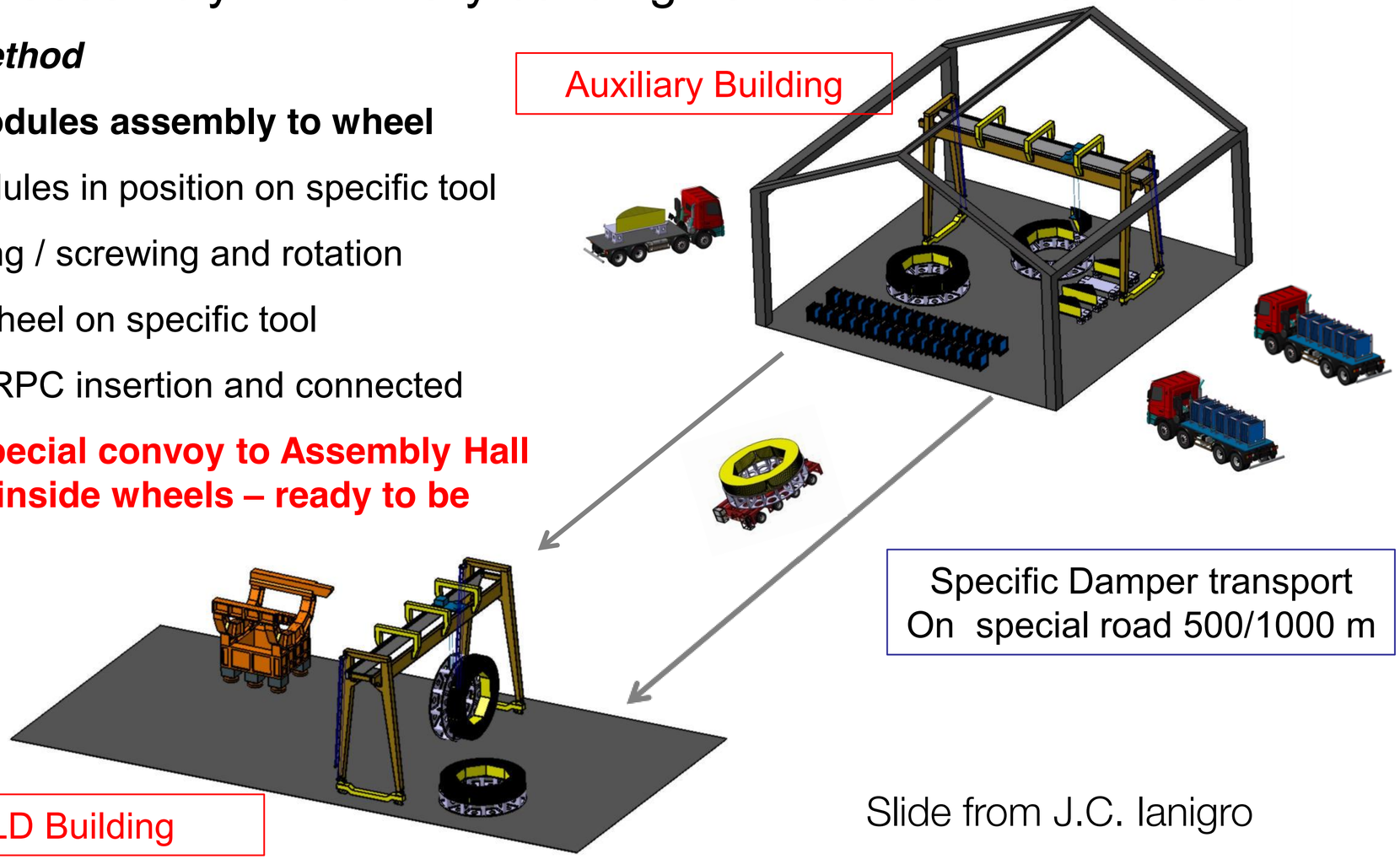
•**Step 1 : Modules assembly to wheel**

- 8 modules in position on specific tool
- welding / screwing and rotation

• **Step 2 :** Wheel on specific tool

• **Step 3** : GRPC insertion and connected

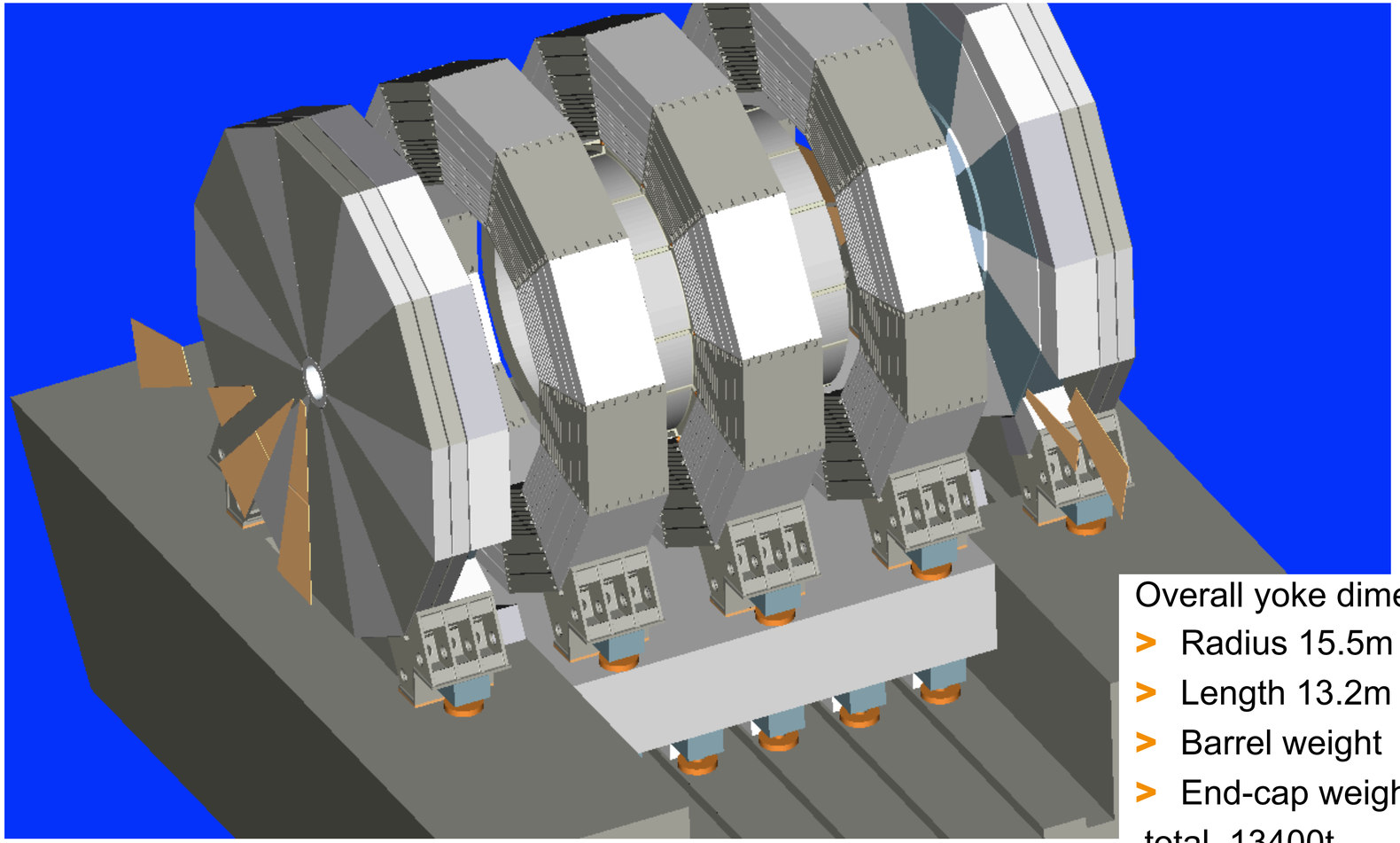
• **Step 4** : **Special convoy to Assembly Hall with GRPC inside wheels – ready to be connected**



Slide from J.C. Ianigro

Heaviest Problem: Iron Yoke

Present Design



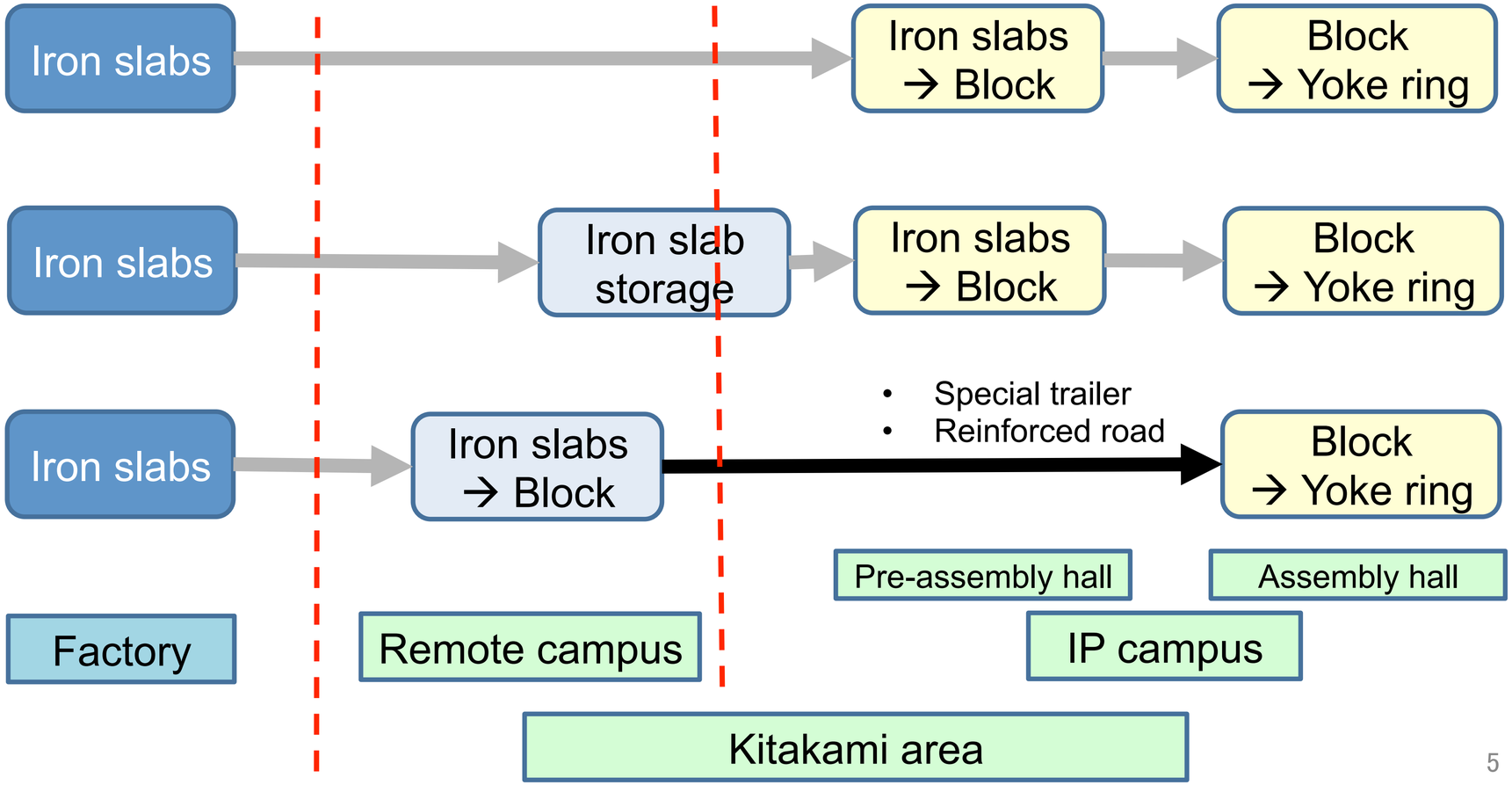
Overall yoke dimensions
- Radius 15.5m
- Length 13.2m
- Barrel weight 6900t
- End-cap weight 6500t

total 13400t

Slide from Uwe Schneekloth

Assembly scenario

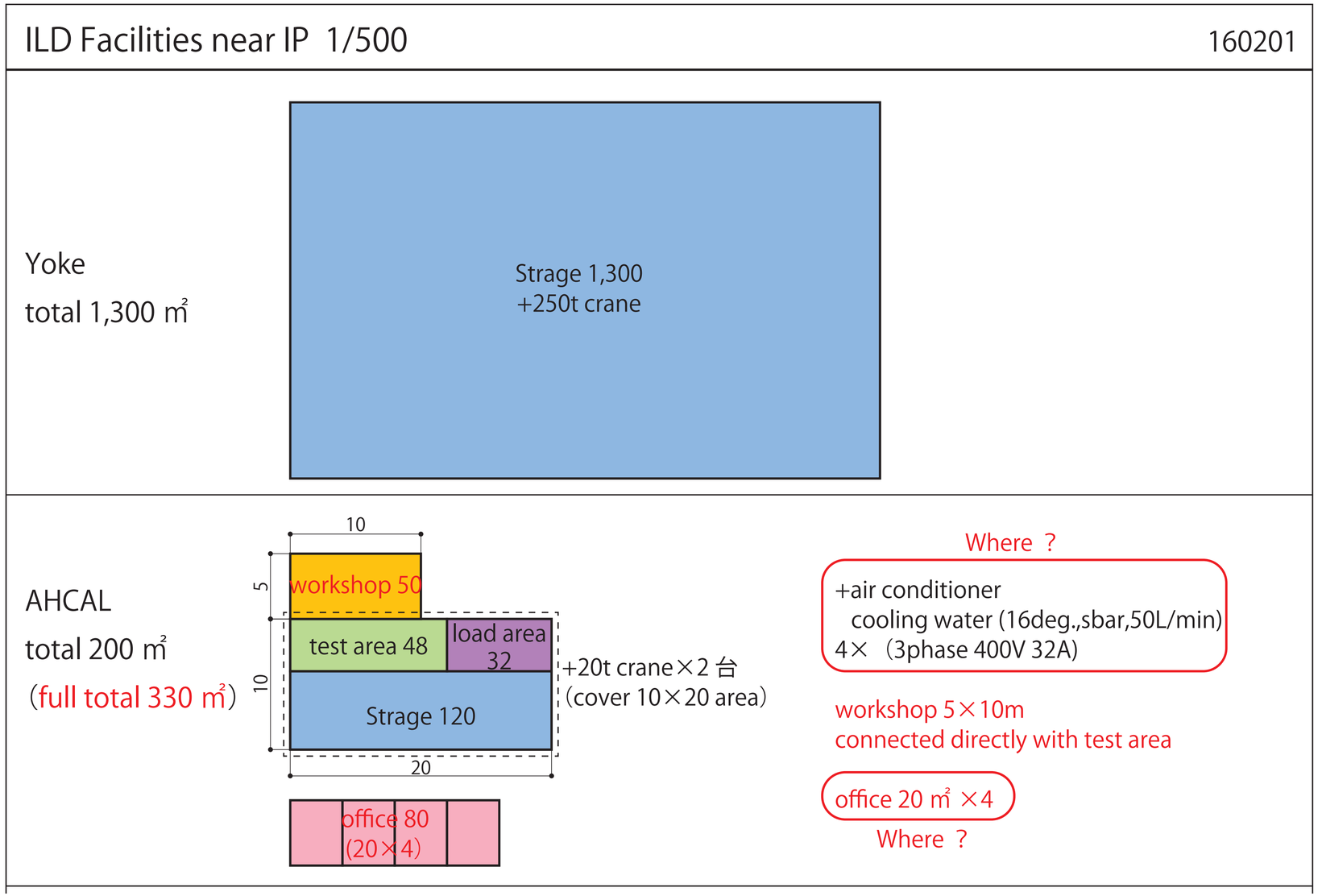
- There are three options



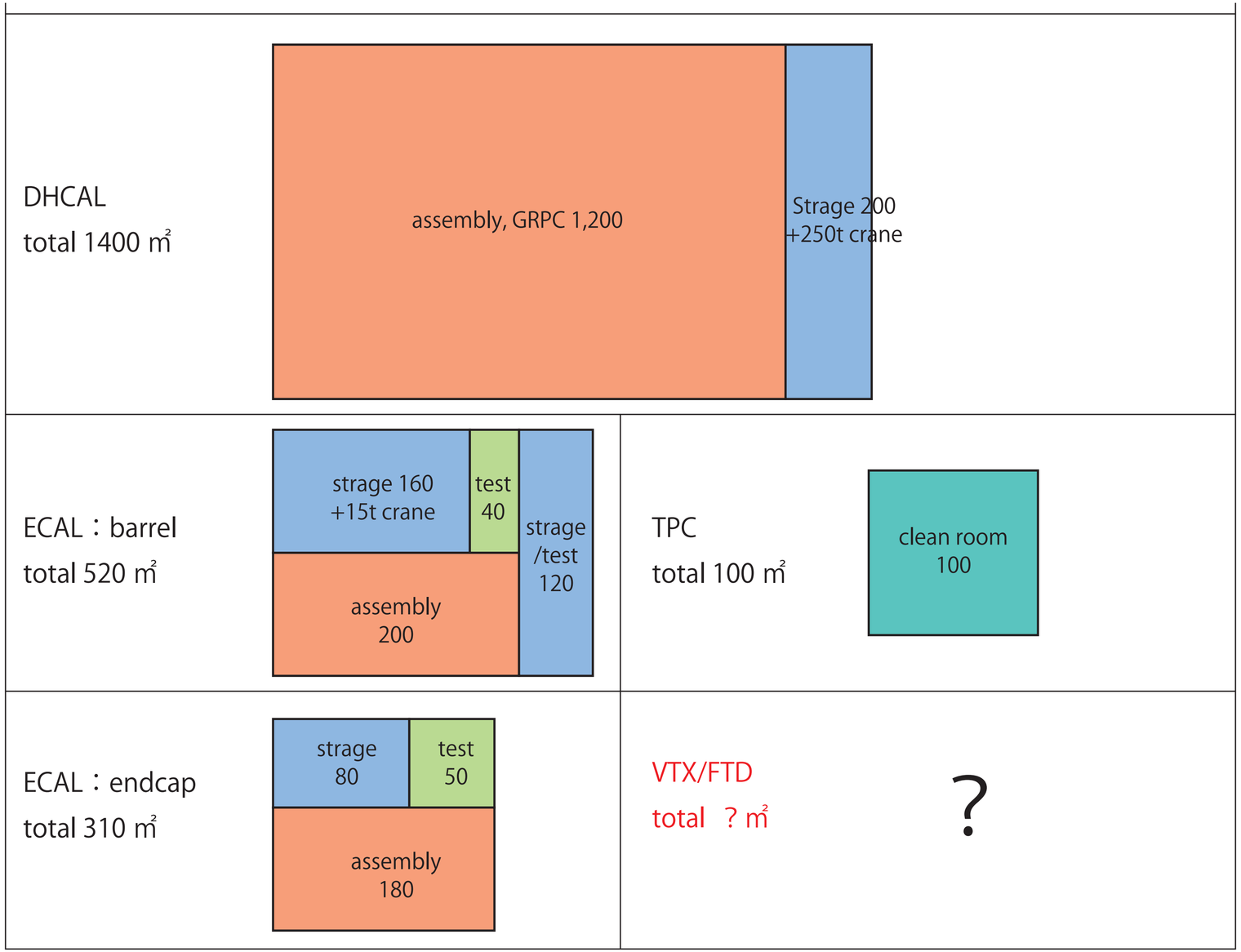
Slide from Uwe Schneekloth

ILD Subdetector Requirements

- Requirements from ILD sub-detectors have been assembled some time ago (02/2016):
  - need to be re-visited
  - in a more formal process



ILD Subdetector Requirements



T. Sanuki, T. Onuki

ILD Interface Documents

Interface control document

Proposal of an Interface Control Document (ICD):

Purpose of this document is:

- To know and record technical details of each subdetector
- To understand the consequences at the interfaces (gap, fixations, weight,)
- Follow up of different progress
-

One document by sub detector

Enter all technical details you know today (dimensions, weight, attachment points, center of gravity, positioning constraints, services, power consumption, thermal dissipation, integration specfications,)

Items may be missing (Please help actively to improve the document)

Each ICD will evolve during the phase of study.

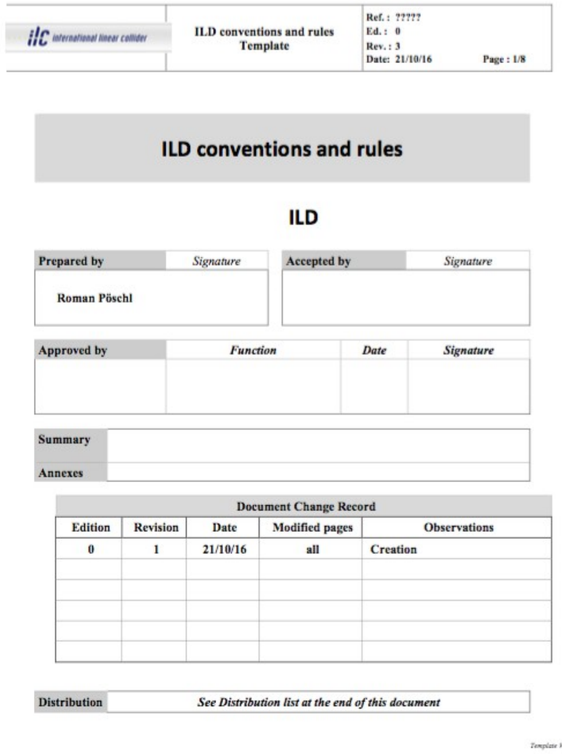
They are not casted in stone yet

- ICD will become backbone of ILD Engineering Design study!!!
- Status will be monitored at ILD (Integration) meetings

R. Poeschl
H. Videau

Three documents

Document on ILD Conventions and rules



ILC international linear collider | ILD conventions and rules Template | Ref. : ????? Ed. : 0 Rev. : 3 Date: 21/10/16 | Page : 1/8

ILD conventions and rules

ILD

Prepared by	Signature	Accepted by	Signature
Roman Pöschl			

Approved by	Function	Date	Signature

Summary	
Annexes	

Document Change Record

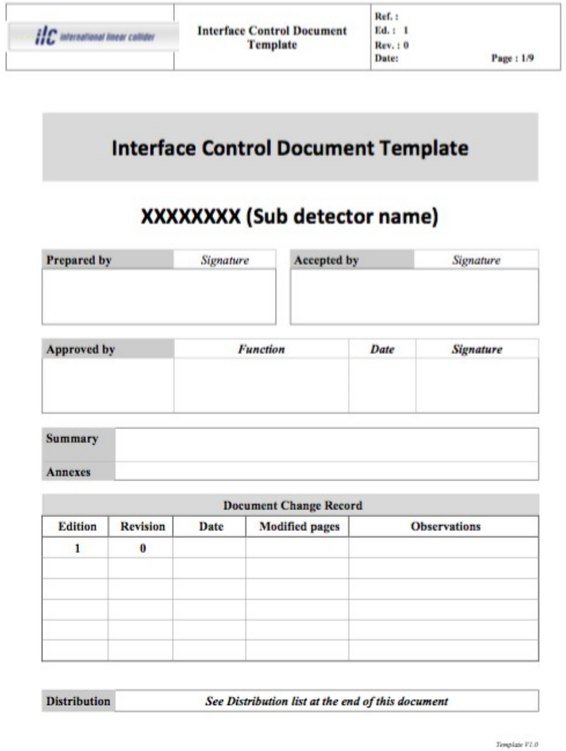
Edition	Revision	Date	Modified pages	Observations
0	1	21/10/16	all	Creation

Distribution	See Distribution list at the end of this document

Template V1.0

Obligatory document:
Author: Central Integration Group

Actual ICD



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Interface Control Document Template

XXXXXXXX (Sub detector name)

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Approved by	Function	Date	Signature

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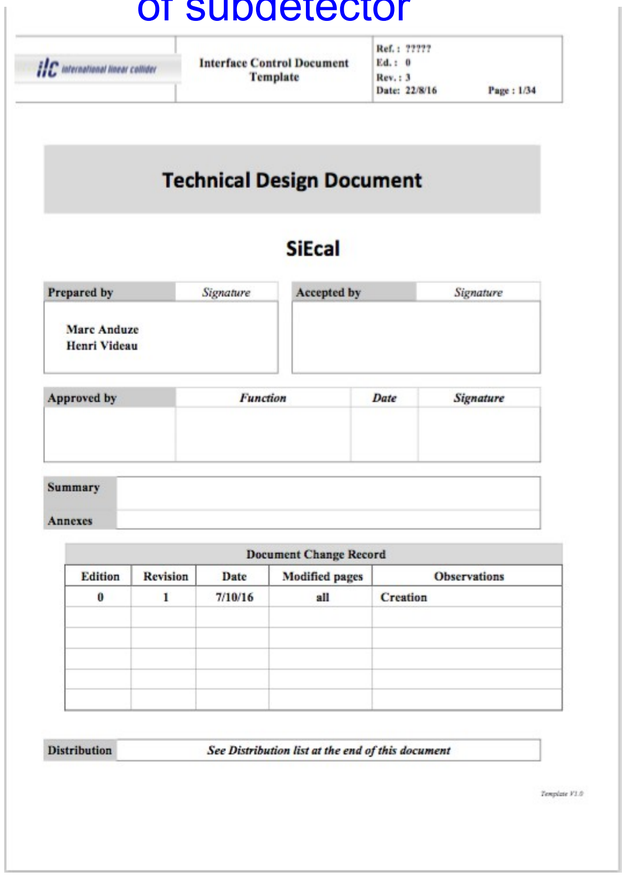
Template V1.0

Obligatory document
Author: Subdetector group

Technical Design Document of subdetector



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Technical Design Document

SiEcal

Prepared by	Signature	Accepted by	Signature
Marc Anduze Henri Videau			

Approved by	Function	Date	Signature

Summary	
Annexes	

Document Change Record

Edition	Revision	Date	Modified pages	Observations
0	1	7/10/16	all	Creation

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Template V1.0

Optional document
(Highly recommended)
Author: Subdetector group
-> See talks by Henri and Marc

R. Poeschl

Convention and Rules Document

Conventions and Rules

- Central Design and Integration group: KB, R. Poeschl, T. Tauchi
- V0.1 on EDMS:

ILD conventions and rules

ILD

Prepared by	Signature	Accepted by	Signature
Roman Pöschl			

Approved by	Function	Date	Signature

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Template V1.0

- Table of Contents -

1. LIST OF ACTIONS

EDMS Nr.: D0000000115315 Rev: A Ver: 1 Status: Released - Dat.: 12. Apr 2017

- Unit conventions
- Coordinate system
- Naming and numbering conventions
- Services
- Local regulations (T. Tauchi):
  - Electrical Appliance and Material Safety Law
  - Fire Service Act
  - High pressure gas safety law
  - Act on Prevention of Radiation Damage by Radioisotope
  - Building Standards Law
  - Corresponding rules at KEK…

3. GLOBAL CONVENTIONS OF ILD

This document constitutes a reference for every document concerning design, construction, assembly of any part of ILD.

3.1. Unit conventions

All the dimensions are given in mm.

3.2. Definition of the ILD reference frame

The origin of the frame is the centre of the interaction region.
We consider that at the interaction point the plane containing both beams is the horizontal plane. This is not trivial considering that the beams are at angle with the magnetic field and have traversed, before the detector, a compensation solenoid. This definition should be inherited from the accelerator. TO BE handled by MDI group
The normal to this plane (vertical) is O_y. Calling P_{e^-} the mean momentum of the electrons and P_{e^+} the mean momentum of the positrons, O_z is proportional to $P_{e^-} - P_{e^+}$. It is close to P_{e^-} with an angle of 7mrad, the two momenta being equal in modulus and their angle being 14 mrad. O_x is deduced to make a right-handed frame.
The centre of the detector is the frame origin, its axis is O_z.
The global shape of ILD is cylindrical. The central part is called "barrel", the barrel is closed on each side by an end cap presenting disk shapes. The two end caps are called "end cap z>0" and "end cap z<0" with obvious definitions. This distinction is not valid for the inner detector part of the detector inside the TPC radius.

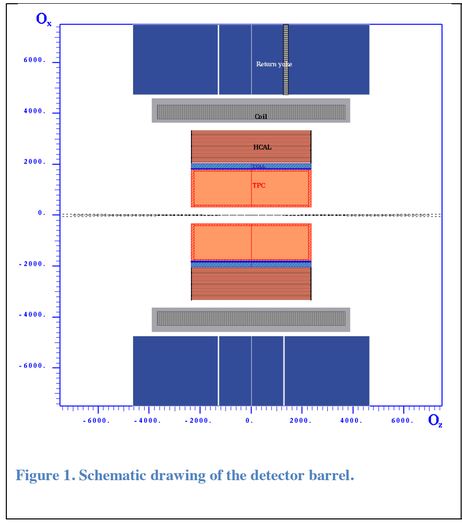

Figure 1. Schematic drawing of the detector barrel.

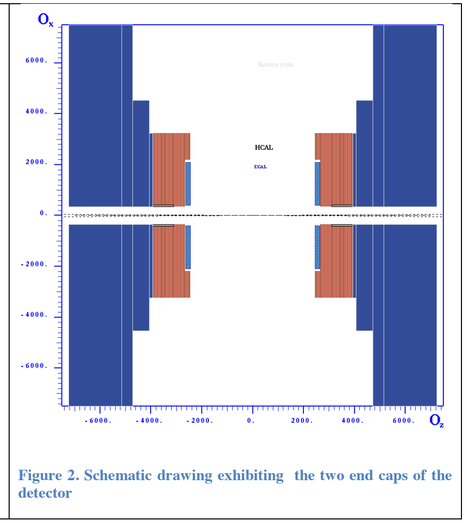

Figure 2. Schematic drawing exhibiting the two end caps of the detector

3.3. Naming and numbering conventions

Numbering definitions and scheme for ILD. The numbering of pieces goes with z for longitudinal structures, it goes with the azimuthal angle in the transverse dimensions. It starts at zero in such a way that multiplied by the angular span of the pieces one gets the angle of the pieces.

3.4. Cable and services path

from the Note on the integration of the ILD detector by C. Clerc and M. Joré

3.5. Detector cabling scheme

Principles

Two main constraints have driven our study:

- Allow maintenance with the minimum of cable disconnections.
- Minimise the number of cables and services in the way of particles

Thus, we propose the following cabling scheme (see figure 3.1.1.1):

- Inner and forward detectors cables/services along the beam
- Barrel detectors cables/services along the coil cryostat and between central and outer rings of barrel yoke. The cable might be distributed in chimneys. This is to be studied completely.
- Endcap detectors cables/services between barrel yoke and Endcap.

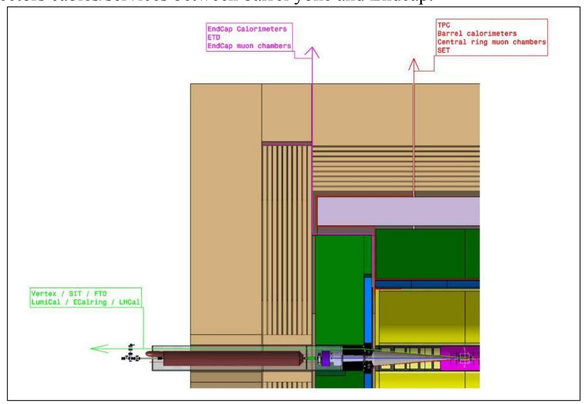

FIGURE 3.1.1.1 Cabling scheme

The inner and forward cables, in green in the figure above, will be routed along the pillar and after to the cable chains. The others cables will be routed to a patch panel connected to the cables chains.

The most delicate issue of this solution lies in the Lumical region. The cables coming from the inner part must find their way out along the Ecal ring, Lumical and support tube, but should not prevent the opening of the endcap. That last point implies a possibility of disconnection. Thus, a quick disconnection device, like a patch panel, is mandatory in this region. NOT TRIVIAL.

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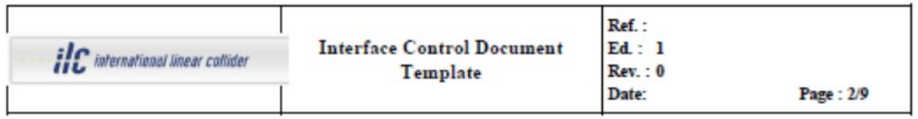
Interface Control Documents

Interface control document



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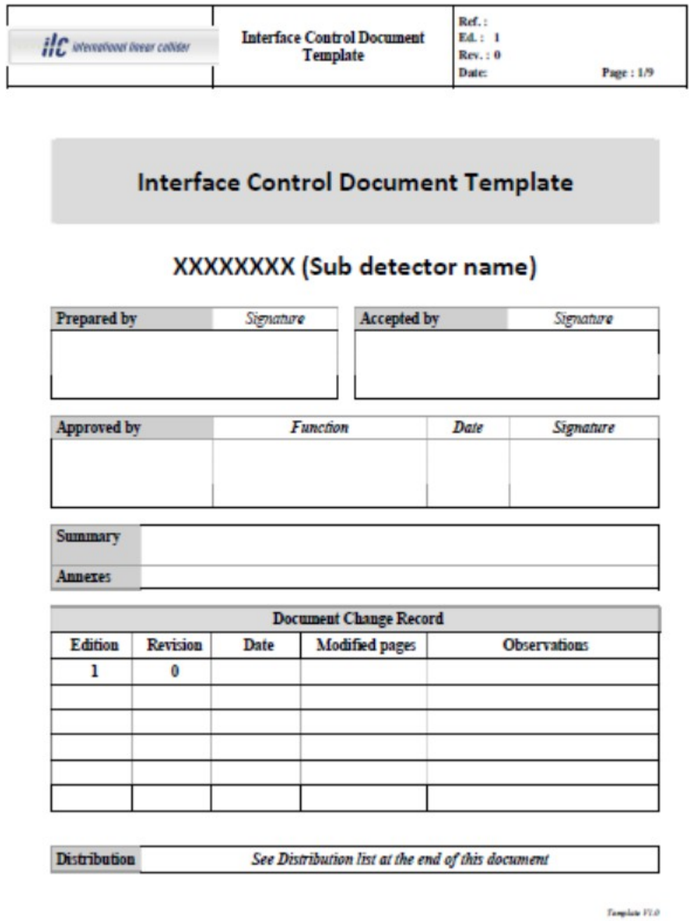

	Interface Control Document Template	Ref. : Ed. : 1 Rev. : 0 Date: Page : 1/9

Interface Control Document Template

XXXXXXXX (Sub detector name)

Prepared by	*Signature*	Accepted by	*Signature*

Approved by	*Function*	*Date*	*Signature*

Summary	
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Edition	Revision	Date	Modified pages	Observations
1	0			

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Template V1.0

R. Poeschl
H. Videau

Template sent to ILD Subdetector groups before Xmass 2016

Towards filling of ICD

- Plan to distribute ICD to ILD by end of July 2016 , i.e. Before the summer break
- R.P. Preferred to went through the excercise for Si Ecal
  Effort was joined and then lead by Henri Videau
- Regular Meetings and discussions since
- It turned out that a lot of conventions have to be reviewed (or being reminded)
  => e.g. creation of a table on nomenclatures

R. Poeschl
H. Videau

1.5. Nomenclature

Nomenclature			
Module	Module	**Overlap**	Distance in z between barrel and end cap
Stave	Set of 5 modules covering an octant of the barrel	**Overshoot**	Amount by which the end cap outer radius exceeds the barrel outer radius.
Slab	Tungsten slab sandwiched between two detecting structures, to be slit in the stave.	**Alveoli layers**	
Alveolus	Hole in the module structure to contain a slab	**Alveoli columns**	

Looks trivial but is very useful

Example: SiECAL

Reference for ICD

- **Until further notice reference for ICD is DBD**
- However, unavoidable changes can be taken into account
  e.g. SiECal Barrel Module

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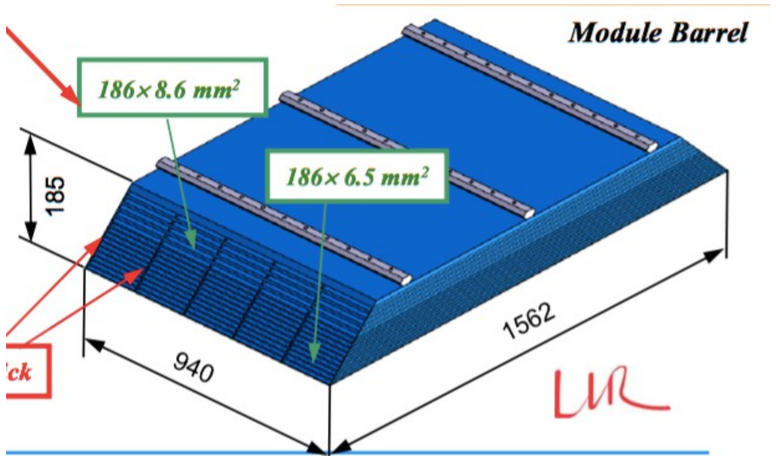
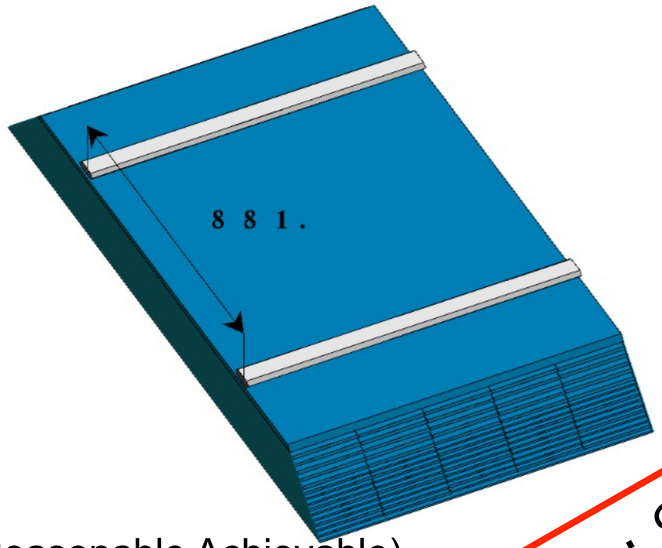
H. Videau

Module with 3 rails → Module with 2 rails





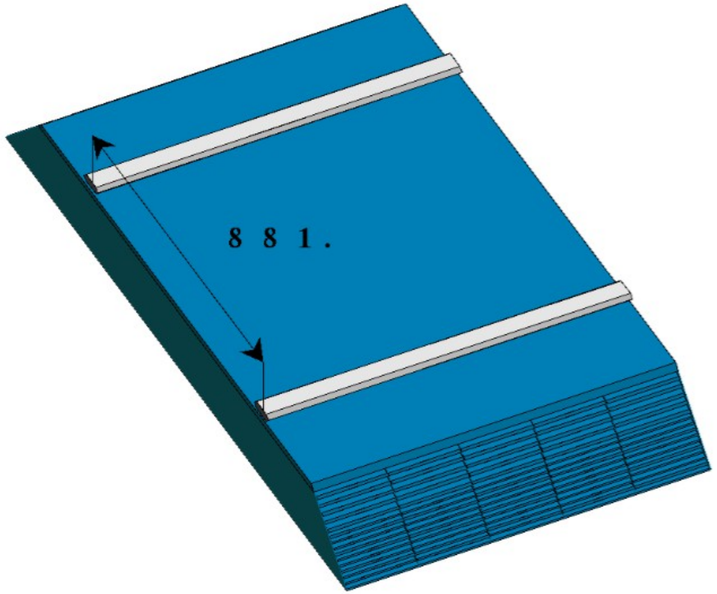
Example: SiECAL

Drawings by M. Anduze

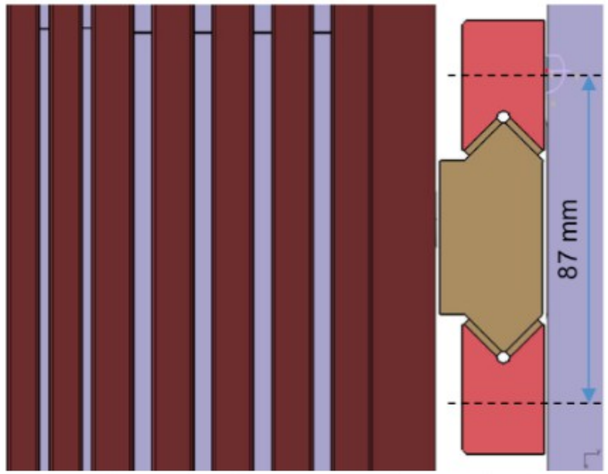
- Keep changes w.r.t. DBD ALARA (As Low As Reasonable Achievable)
  - Document them clearly
- How to deal with modified L*

ICD SiECal – Example I

SiEcal Barrel Module with rails



Fastening of SiEcal Module to Hcal



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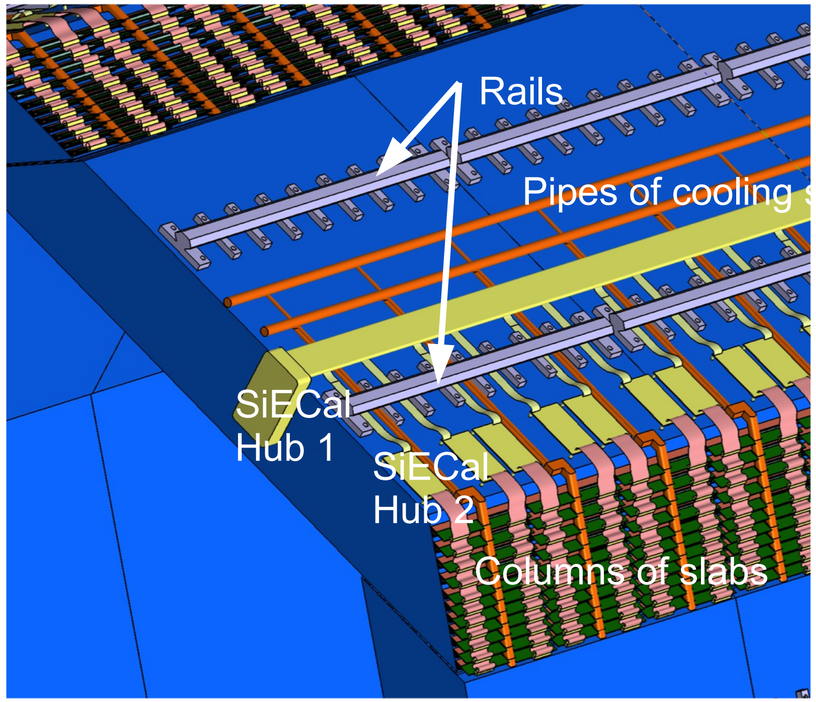
H. Videau

Example: SiECAL

(Here) ICD should give information about

- distance between rails
  => Constraints on positions of female rails -> see talk by Marc
- Should not give information on e.g. the design of the alveolar layers

ICD SiECal – Example II



SiECal external components
i.e. Relevant for ICD

- SiEcal Hub 1
  (hub to external supplies and DAQ)
- Rails (connection to Hcal

SiECal internal components
i.e. Relevant for TDD

- Cooling pipes,
- SiEcal Hub2 (internal hub)
- Slab columns

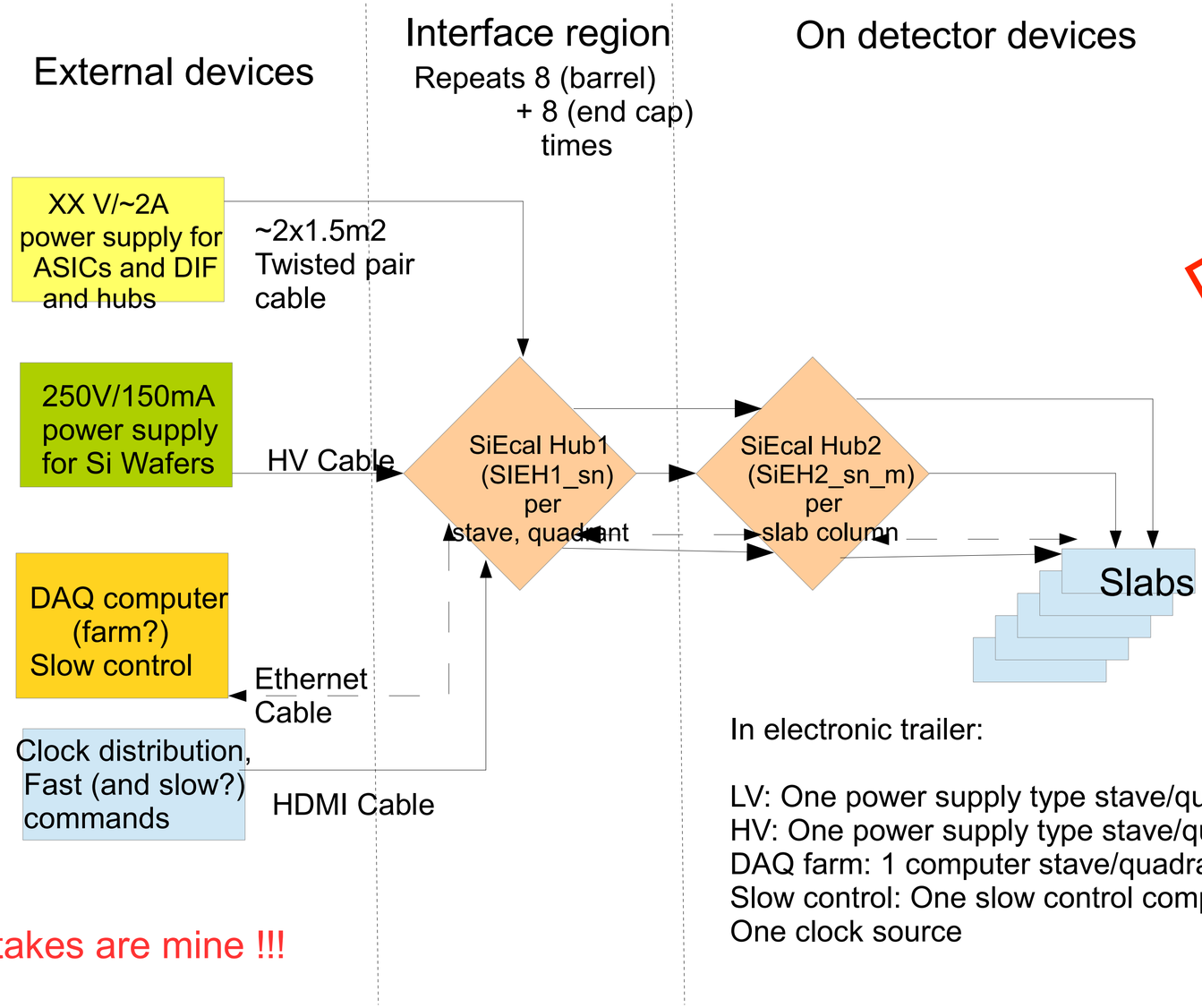
... as long as they don't exceed the space between ECal and HCal or influence detectors in another way (heat, interspersed noise, etc.)

R. Poeschl
H. Videau

Example: SiECAL

Disclaimer: Design subject to change

Supplies – Naive block scheme



Example: SiECAL

R. Poeschl
H. Videau

In electronic trailer:

LV: One power supply type stave/quadrant
HV: One power supply type stave/quadrant
DAQ farm: 1 computer stave/quadrant for acquisition
Slow control: One slow control computer
One clock source

All mistakes are mine !!!

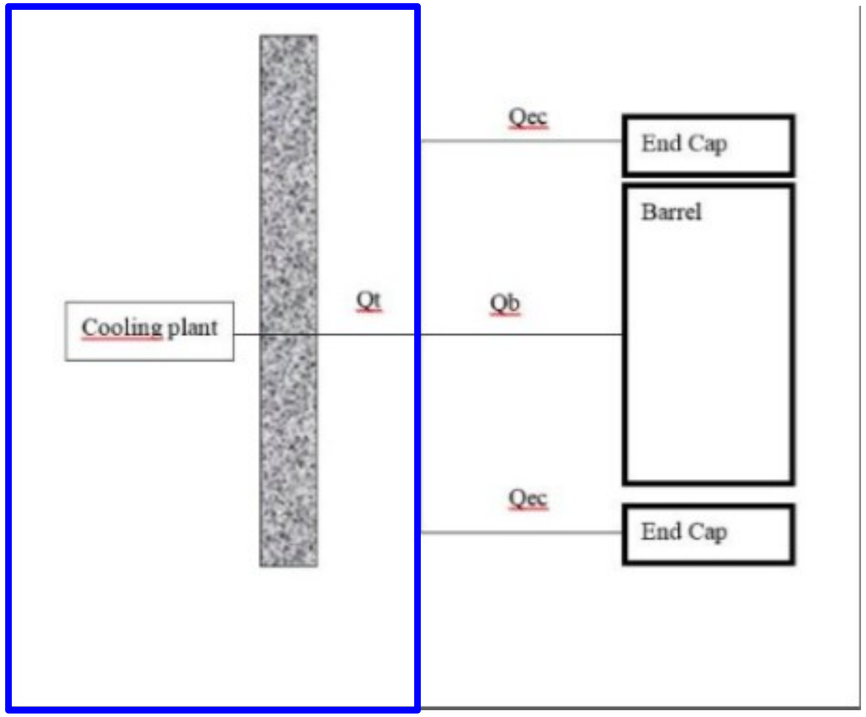
ILD Integration Process

- We hope to get a more reliable picture about the requirements and interfaces for the ILD sub-detectors via a formal process using Interface Control Documents
- This process will converge only slowly, as a lot of the information is not available at this stage:
  - R&D for detectors and electronics proceeds
  - Understanding the dependencies between the sub-detectors and the outer world is difficult and depends on many details
- Nevertheless, we hope to have a first - incomplete and maybe inconsistent - picture before the end of this year
- The output of this process should also be a better picture of all interfaces that ILD has with the outer world:
  - Experimental areas - surface and underground
  - IP campus
  - Main campus

Interface to the Environment

ICD Document – General part example

SiEcal Cooling System – Very schematic view



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H. Videau

Concept by D. Grondin

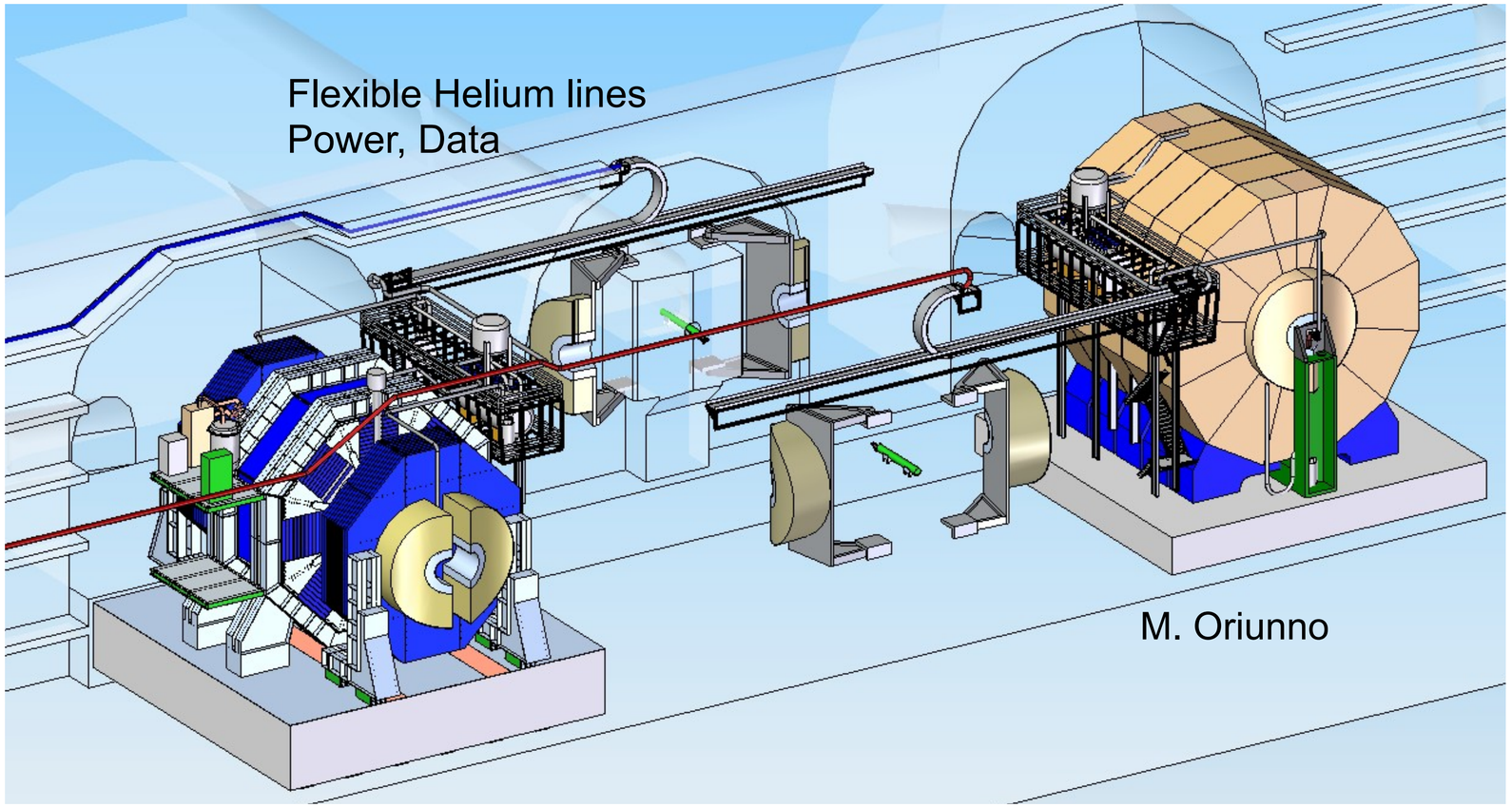
Where to locate such a cooling plant?
Other examples:

- Gas supply systems
- Electronic trailer

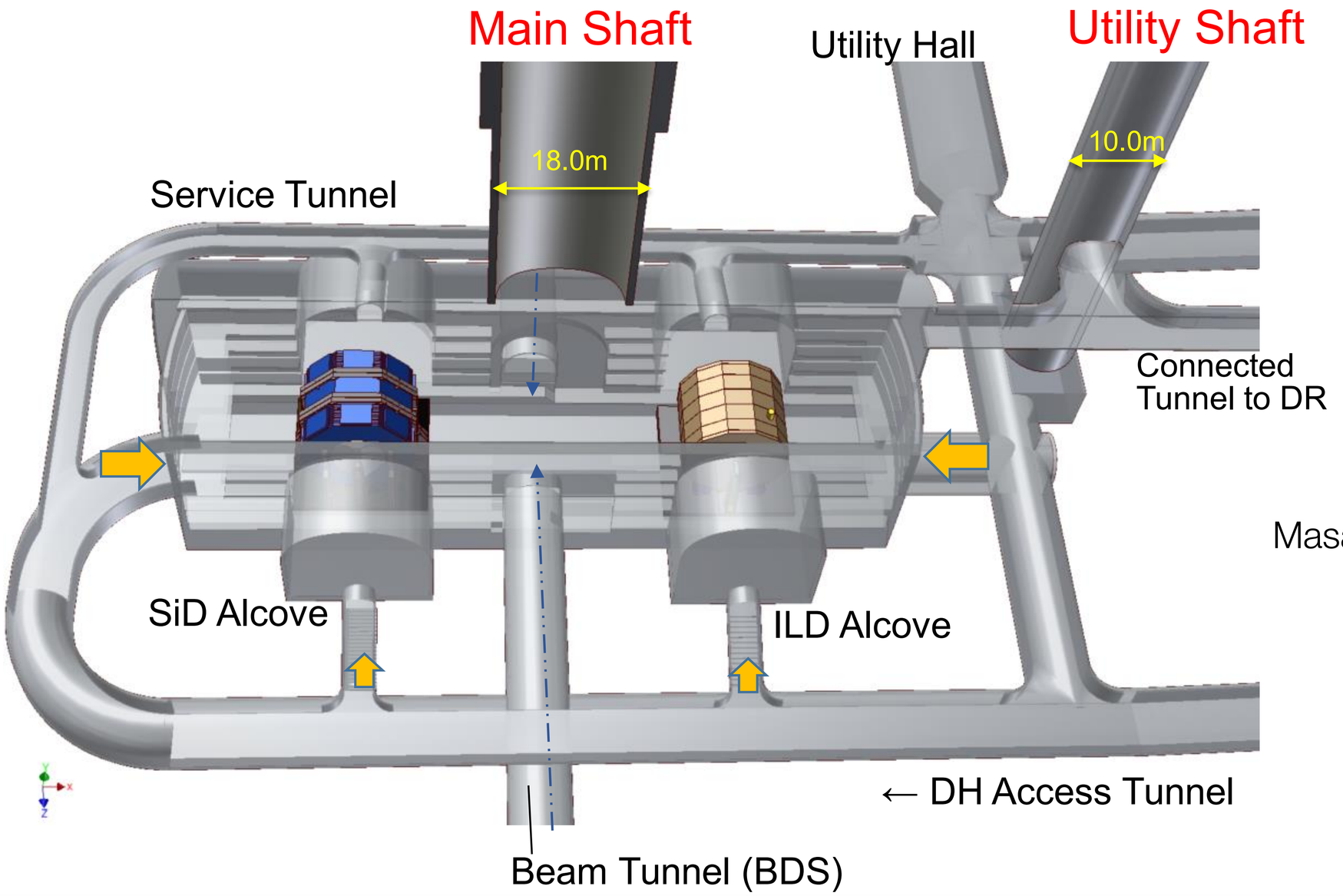
Example: SiECAL

Push-pull System

- ILD lives on a moving platform
  - In symbiosis with SiD and the machine…
- Where to put the external services?
- First, we need the sub-detector requriements!



Detector Hall and two Vertical Shafts



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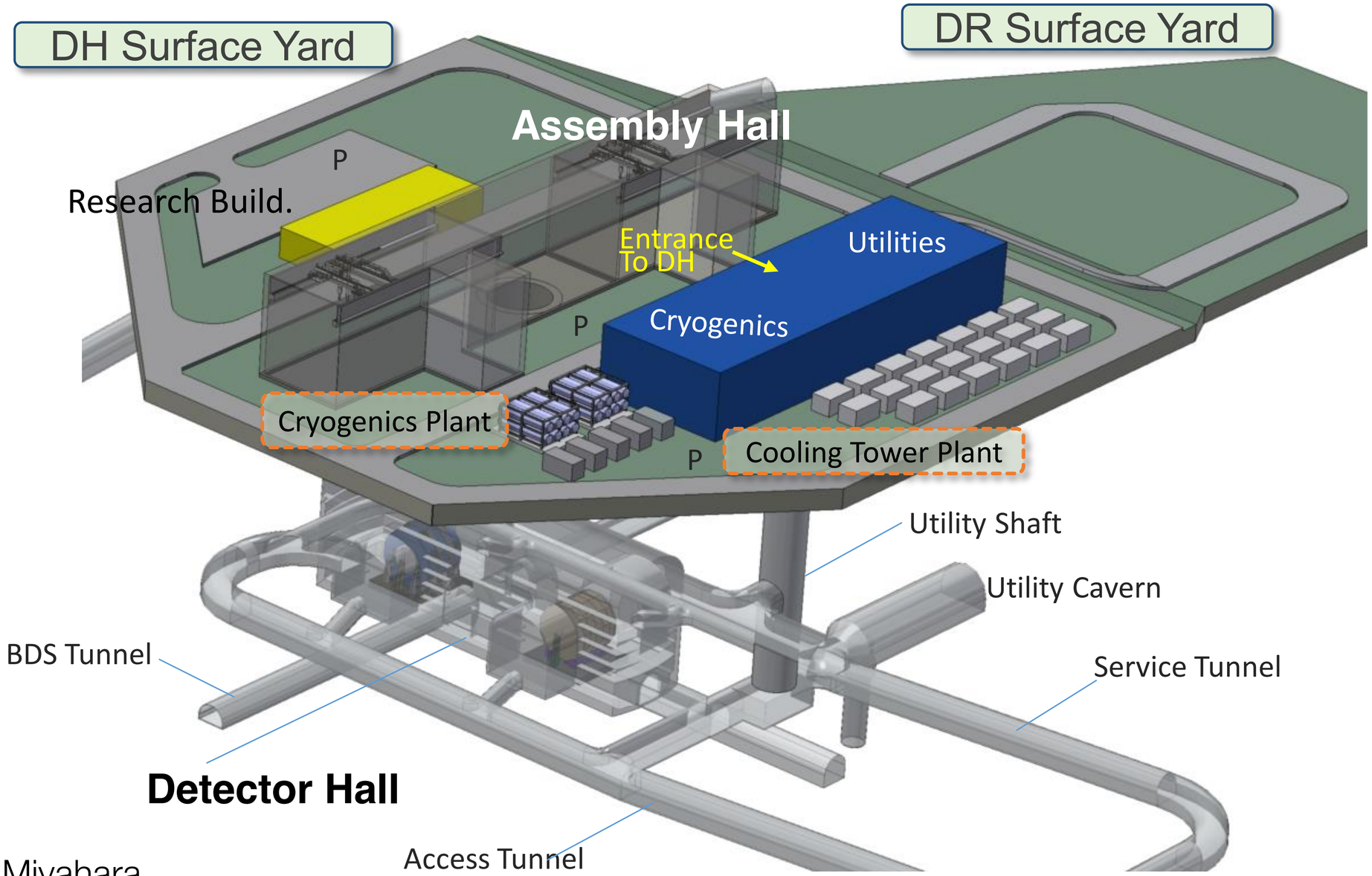
Overall Facilities of the DH Region

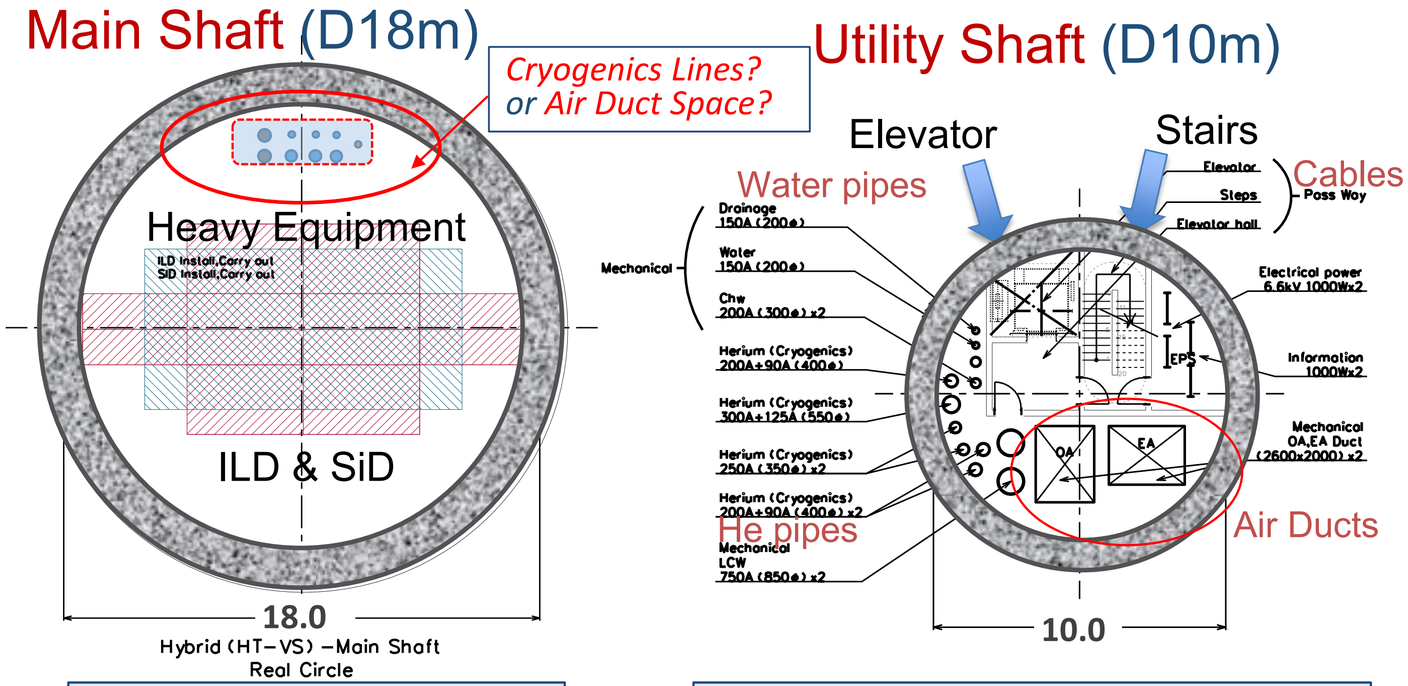


Access Shafts

- 18 m main shaft for detector installation
  - plus some services
- 10 m shaft for
  - elevators
  - stairs
  - power, cooling, air conditioning, gas supplies, (…)

- We need to know how much of this is required by ILD!

Two Vertical Shafts



Main shaft D=18m
- Center of DH
- Detectors Installation by Gantry Crane

Utility shaft D=10m
- Utility lines: Pipes, ducts, cables
- Personnel access to Detector Hall by Elevator and Stairs

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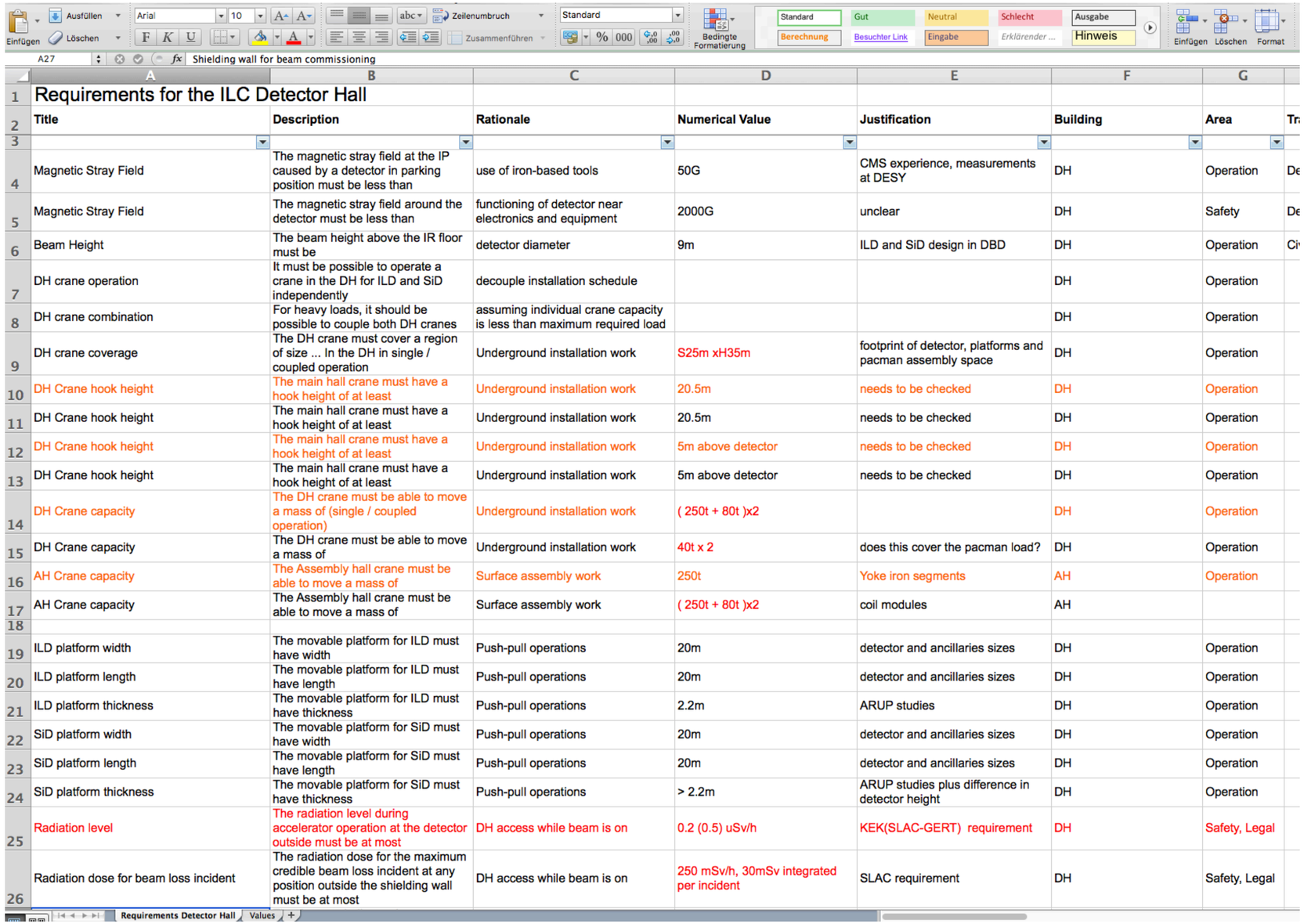
ILD Requirements for Experimental Hall

B. List,
T. Tauchi,
KB



A27: Shielding wall for beam commissioning

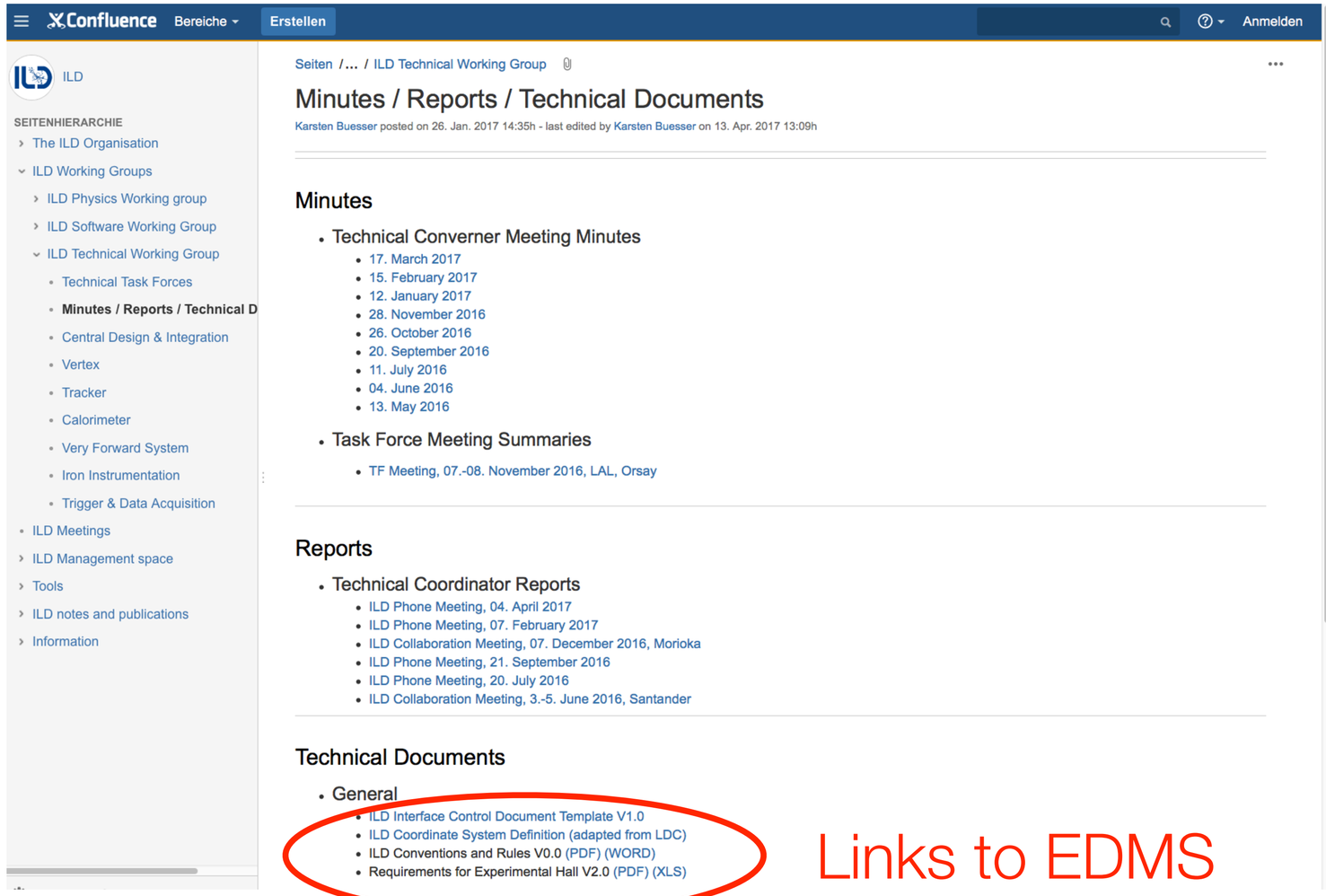
Requirements for the ILC Detector Hall

Title	Description	Rationale	Numerical Value	Justification	Building	Area	Tr
Magnetic Stray Field	The magnetic stray field at the IP caused by a detector in parking position must be less than	use of iron-based tools	50G	CMS experience, measurements at DESY	DH	Operation	De
Magnetic Stray Field	The magnetic stray field around the detector must be less than	functioning of detector near electronics and equipment	2000G	unclear	DH	Safety	De
Beam Height	The beam height above the IR floor must be	detector diameter	9m	ILD and SiD design in DBD	DH	Operation	Ci
DH crane operation	It must be possible to operate a crane in the DH for ILD and SiD independently	decouple installation schedule			DH	Operation	
DH crane combination	For heavy loads, it should be possible to couple both DH cranes	assuming individual crane capacity is less than maximum required load			DH	Operation	
DH crane coverage	The DH crane must cover a region of size ... In the DH in single / coupled operation	Underground installation work	S25m xH35m	footprint of detector, platforms and pacman assembly space	DH	Operation	
DH Crane hook height	The main hall crane must have a hook height of at least	Underground installation work	20.5m	needs to be checked	DH	Operation	
DH Crane hook height	The main hall crane must have a hook height of at least	Underground installation work	20.5m	needs to be checked	DH	Operation	
DH Crane hook height	The main hall crane must have a hook height of at least	Underground installation work	5m above detector	needs to be checked	DH	Operation	
DH Crane hook height	The main hall crane must have a hook height of at least	Underground installation work	5m above detector	needs to be checked	DH	Operation	
DH Crane capacity	The DH crane must be able to move a mass of (single / coupled operation)	Underground installation work	(250t + 80t)x2		DH	Operation	
DH Crane capacity	The DH crane must be able to move a mass of	Underground installation work	40t x 2	does this cover the pacman load?	DH	Operation	
AH Crane capacity	The Assembly hall crane must be able to move a mass of	Surface assembly work	250t	Yoke iron segments	AH	Operation	
AH Crane capacity	The Assembly hall crane must be able to move a mass of	Surface assembly work	(250t + 80t)x2	coil modules	AH		
ILD platform width	The movable platform for ILD must have width	Push-pull operations	20m	detector and ancillaries sizes	DH	Operation	
ILD platform length	The movable platform for ILD must have length	Push-pull operations	20m	detector and ancillaries sizes	DH	Operation	
ILD platform thickness	The movable platform for ILD must have thickness	Push-pull operations	2.2m	ARUP studies	DH	Operation	
SiD platform width	The movable platform for SiD must have width	Push-pull operations	20m	detector and ancillaries sizes	DH	Operation	
SiD platform length	The movable platform for SiD must have length	Push-pull operations	20m	detector and ancillaries sizes	DH	Operation	
SiD platform thickness	The movable platform for SiD must have thickness	Push-pull operations	> 2.2m	ARUP studies plus difference in detector height	DH	Operation	
Radiation level	The radiation level during accelerator operation at the detector outside must be at most	DH access while beam is on	0.2 (0.5) uSv/h	KEK(SLAC-GERT) requirement	DH	Safety, Legal	
Radiation dose for beam loss incident	The radiation dose for the maximum credible beam loss incident at any position outside the shielding wall must be at most	DH access while beam is on	250 mSv/h, 30mSv integrated per incident	SLAC requirement	DH	Safety, Legal	

Requirements Detector Hall | Values

It’s on EDMS/Confluence!

- ILD Interface Documents and list with requirements for experimental hall are on EDMS and ILD Confluence
- Links from ILD Confluence to newest releases:
- https://confluence.desy.de/pages/viewpage.action?pageId=45738956
- On: https://confluence.desy.de/display/ILD/ILD



Links to EDMS

Conclusions

- We have first estimates of the requirements for the environments (surface and underground) of ILD:
  - space for assembly, maintenance and operations
  - services and supplies
- We try to get more reliable number by introducing a more formal process on the integration of ILD
  - Interface Control Documents
  - Convention and Rules
- We expect to have a first - probably still incomplete - picture before the end of the year
- Started also with a list of requirements for the experimental hall
- ILD is still evolving, sub-detector technologies not everywhere decided, R&D on-going
  - a somewhat moving target
- Still try to get the best picture that we can have at this time

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