LINEAR COLLIDER COLLABORATION

Designing the world's next great particle accelerator

LCWS14 - Belgrade

October 6-10, 2014

Conventional Facilities & Siting Working Group Summary

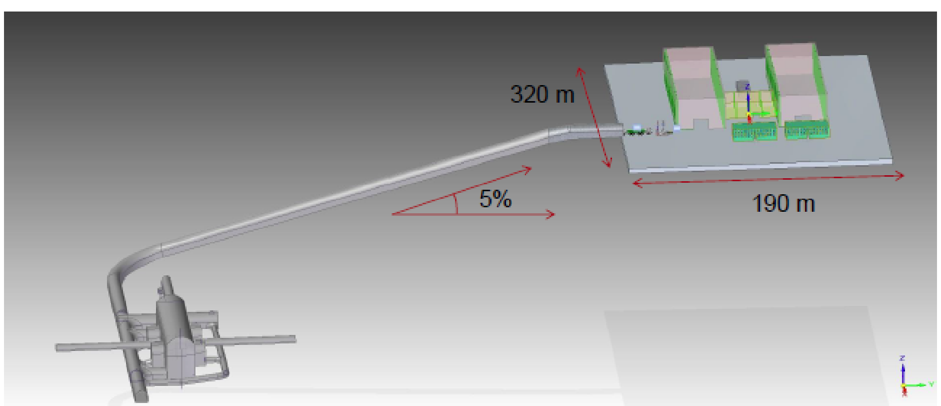
V Kuchler, M Miyahara, J Osborne

CFS & MDI & Detector Parallel Session

- ***Change request for Hybrid A' Interaction Region Layout (K.Buesser)***
- ***Document ready for submittal to review panel for IR access change to vertical shafts***

Baseline Detector Hall Scenario (TDR)

- TDR assumed Japanese site would be very mountainous - no flat top area to place a surface installation atop the underground areas
- Access to underground areas via horizontal tunnel of ~1km length and up to 10% slope
- Detector installation mostly underground



Undergound Detector Hall

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CHANGE REQUEST NO. ILC-CR-000N	EDMS No: D0000000xxxxxxx	Created: 16-09-2014 Last modified: 24-09-2014

DETECTOR HALL WITH VERTICAL SHAFT ACCESS

Change the underground experimental hall to a design that has a large vertical shaft and allows for the "CMS style" assembly of the detectors.

RATIONALE

Introduction

The baseline (TDR) design of the interaction region (IR) for the ILC in Japan foresees an underground experimental hall that can be accessed only via a horizontal O(1km) long tunnel of ~11m width and a slope of O(7%). This has been defined before the Kitakami site has been selected for the ILC in Japan under the assumption that any Japanese site would be in a mountainous area that does not allow to have an assembly and maintenance area directly on top of the underground IR. The Kitakami site, however, allows to find a position for the IR that has a reasonably flat area above the IR and where a vertical shaft of O(70m) length could be built to access the underground areas.

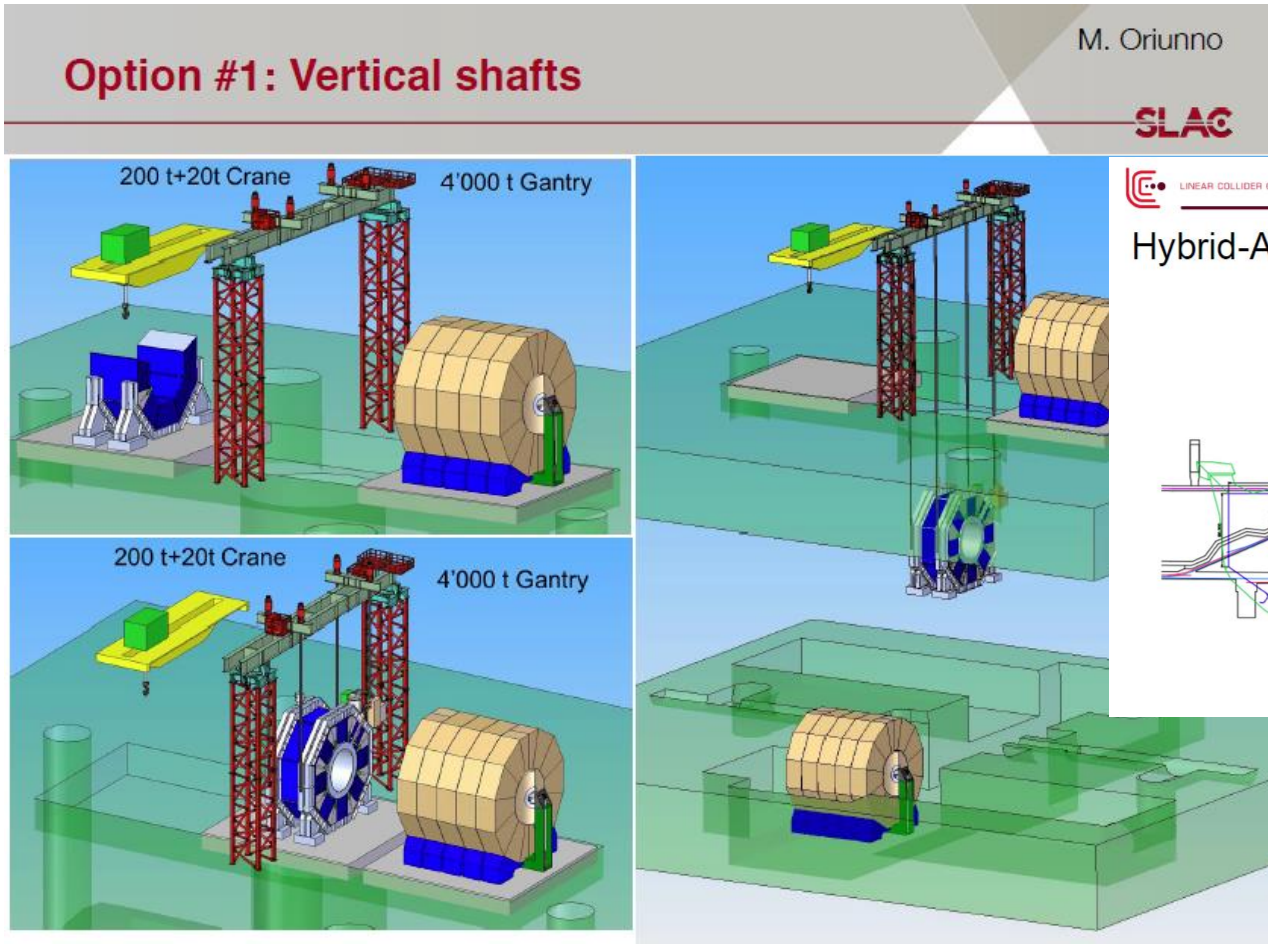
Detector Assembly and Timelines

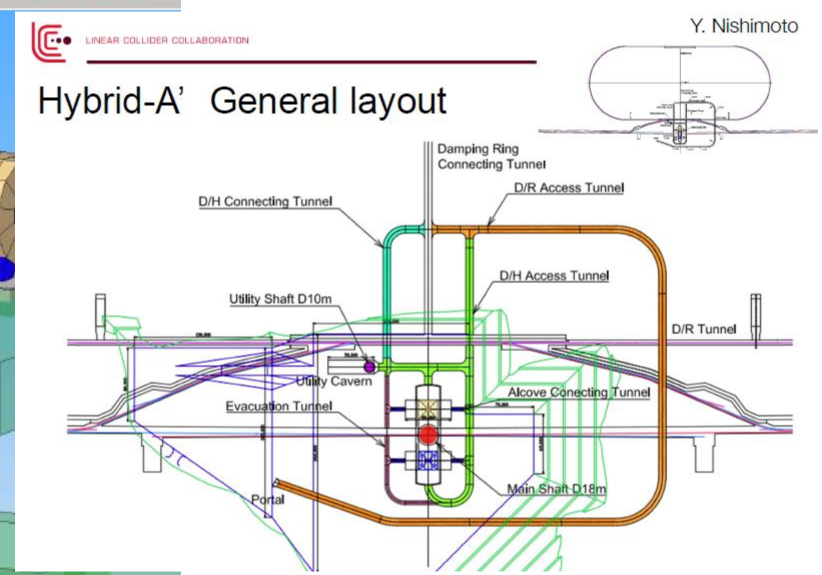
In the "CMS assembly style", both detectors will be assembled and tested mainly on surface. This is especially of significance for the detector magnet systems (solenoids and yokes). The large pre-assembled pieces will be lowered via the vertical shaft into the underground hall using a temporary gantry crane that can lift O(4000t). The lowering of the detector parts happens rather late in the ILC construction schedule, about 1-2y before the start of beam commissioning. In the baseline version that allows only access via a horizontal tunnel, the detectors need to be assembled from smaller pieces. This requires a longer underground assembly time (~3y) and more underground assembly space. The vertical access design therefore decouples to a larger extent the time lines for the CFS work and the installation of the machine and the detectors. This

EDMS ID: 0 Page 1 of 9

CFS & MDI & Detector Parallel Session

- ***New detector installation method now similar to CMS***
- ***Full impact of 50ton (approx.) road transport limit still to be fully assessed***





CFS planning for pre-construction period

- Financial planning for pre-construction period reviewed
- ARUP experience on previous projects and CERN Future Circular Collider (FCC) by M.Sykes and Y.Loo
- Typical Site investigation, prior to construction start :

- Tunnel Projects: ~1.5% of Project Cost (Buildings: ~0.2% of cost)

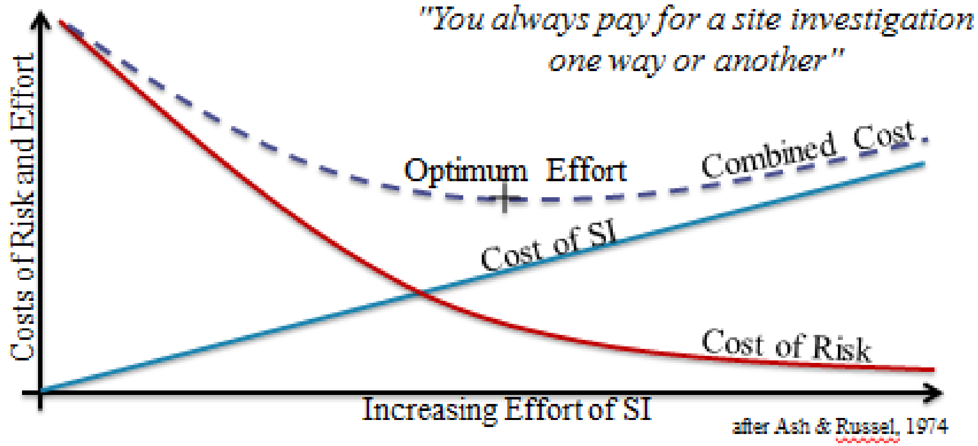
Project	Length of Tunnel, km	Length of Holes Bored, km	Bore length /m of tunnel
Lake Mead, USA	4.7	2.9	0.6
Koralm, Austria	32.9	21.0	0.6
Glendoe, UK	6	1.4	0.2
YPL, UK - Stage 1	36.0	3.3	0.1
Point 1, Point 5, LHC	-	2.8	-

- BH Length:Tunnel Length - (0.5 to 1.5)
  - Generally considered the level at which risk of cost overruns are reduced to an acceptable level
  - Need to a/c for deep-drilled boreholes / borehole spacing

Footer title ARUP

CFS planning for pre-construction period

- ***Cost of Site Investigation v Project Risk***



Site investigation costs as % of tender price	Increase in costs of construction (%)	
	Range	Mean
<1	0 - 100	26
1-3	0 - 50	26
3-4	0 - 30	15
>4	0 - 15	8

after Whyte, 1998

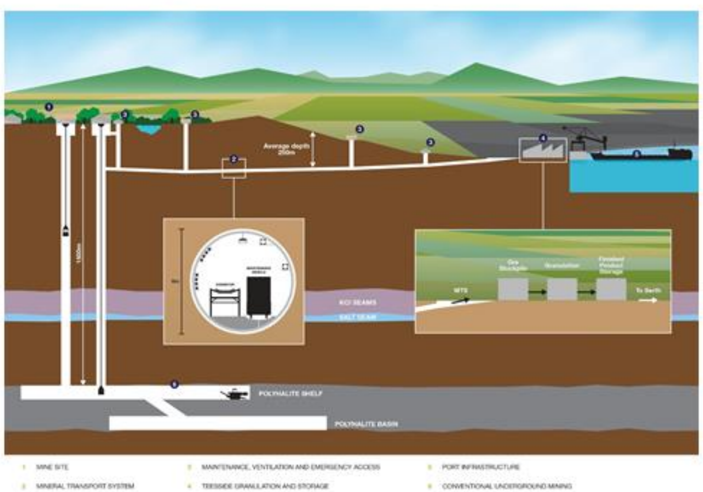
r title

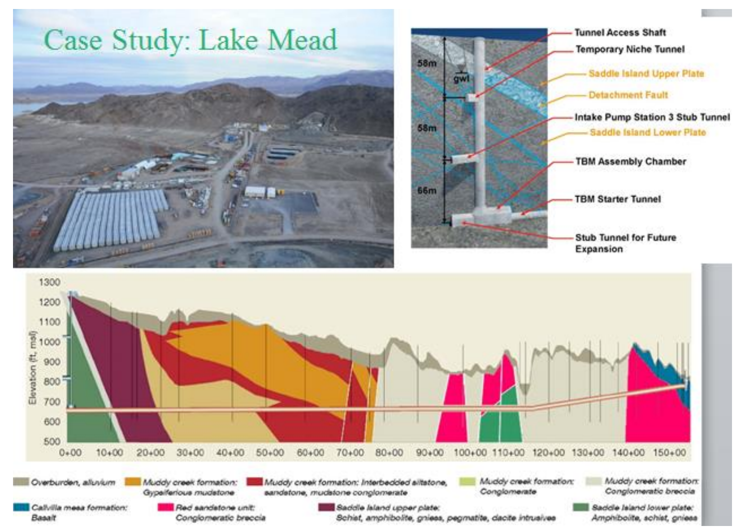
ARUP

CFS planning for pre-construction period

- ***ARUP presented some case studies***
- ***For example, York Potash located in a national park in UK, difficult to drill boreholes***
- ***Access for drilling rigs sometimes impossible***
- ***Risk register recommended to assess cost of Site Investigation against out-turn construction costs***

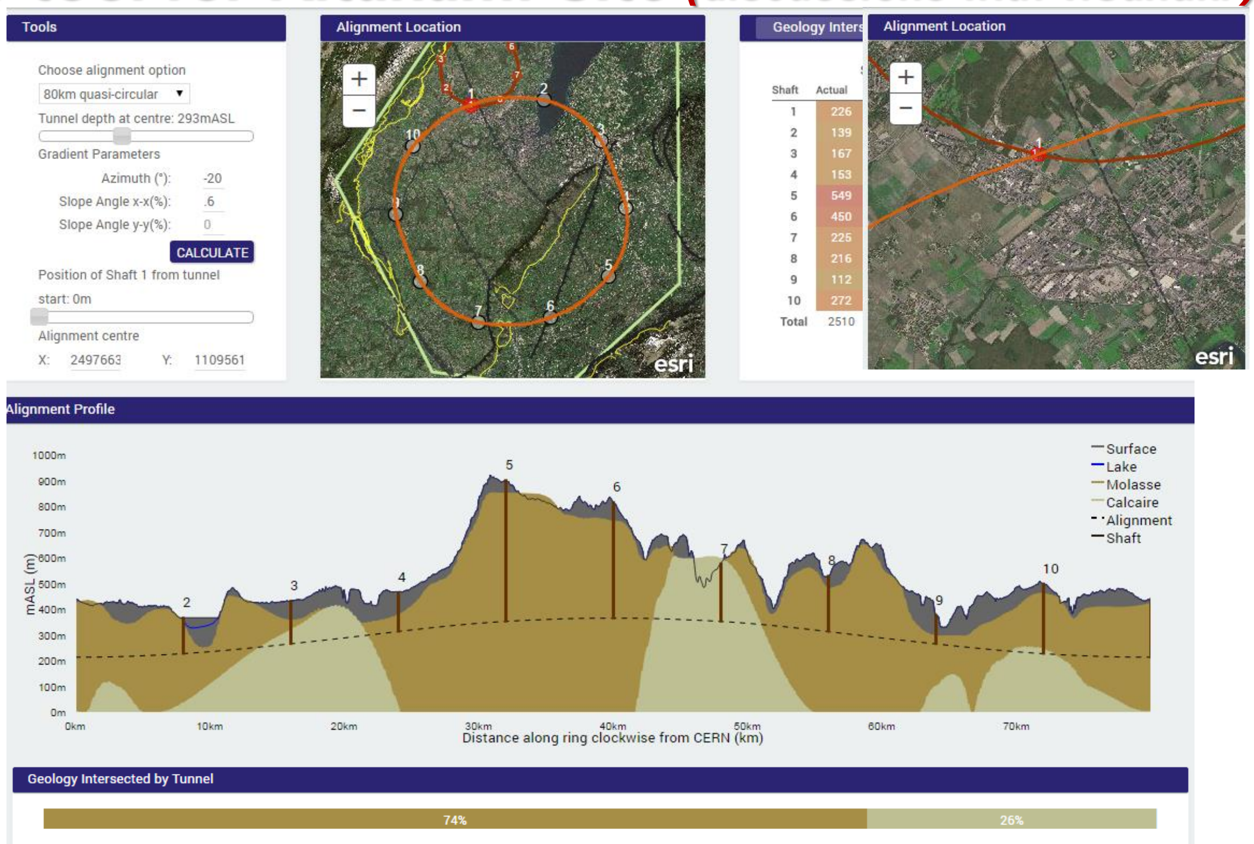
Case Study: York Potash





CFS planning for pre-construction period

- ***ARUP have developed a bespoke BIM Tunnel Optimisation Tool (TOT) for CERN FCC.***
- ***3d geological tool for evaluating the possible layouts***
- ***Investigation underway to see if ARUP can provide a similar tool for Kitakami Site** (discussions with T.Sanuki)*

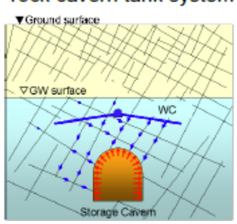


CFS planning for pre-construction period

- *J-Power experience from Y.Nishimoto on underground project in Japan*

Underground LPG stockpiling Project

Underground water-sealed rock cavern tank system



Gas and oil are stored in cavern tank by the effect of groundwater pressure safely

- 5 National LPG Stockpiling Bases in Japan
- Underground water-sealed rock cavern tank system is used for 2 of LPG Stockpiling base

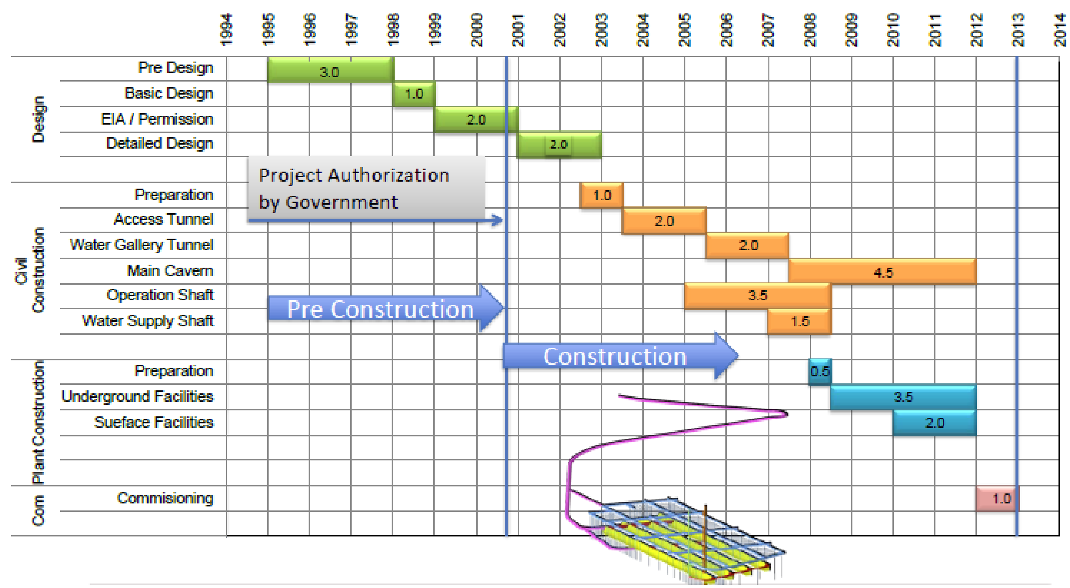
Owner : JOGMEC

Independent Administrative Cooperation

Milestone

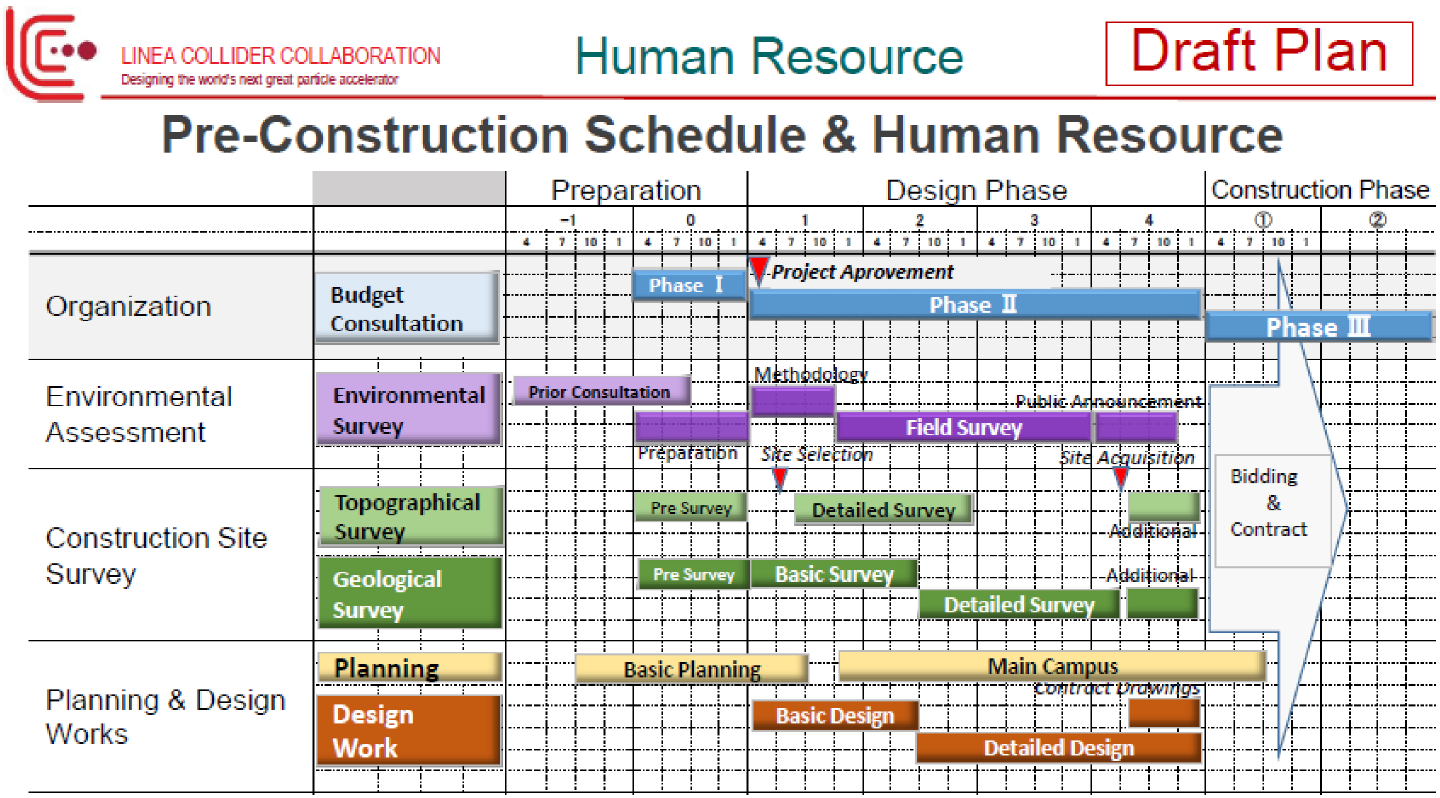
- Project plan is established 1981
  according to the petroleum reserve low
- Construction authorized at 2001
- Construction : 2002 – 2012
- Operation commencement : 2013

Construction Schedule (Kurashiki base)



CFS planning for pre-construction period

- ## CFS schedule & Human Resource plan (M.Miyahara)



		-1	0	1	2	3	4	①	②
In-house	Management	–	1	1	1	1	1		
	Administration Dep.	–	1	1	4	4	4		
	Engineering Dep.	–	1	2	5	5	5		
Outsource	Management	–	0	0	2	2	2		
	Administration Dep.	–	1	1	9	9	5		
	Engineering Dep.	–	1	6	17	17	17		
Total	Total	–	5	11	38	38	38		

CFS planning for pre-construction period

- ***CFS Site Investigation plan (M.Miyahara)***

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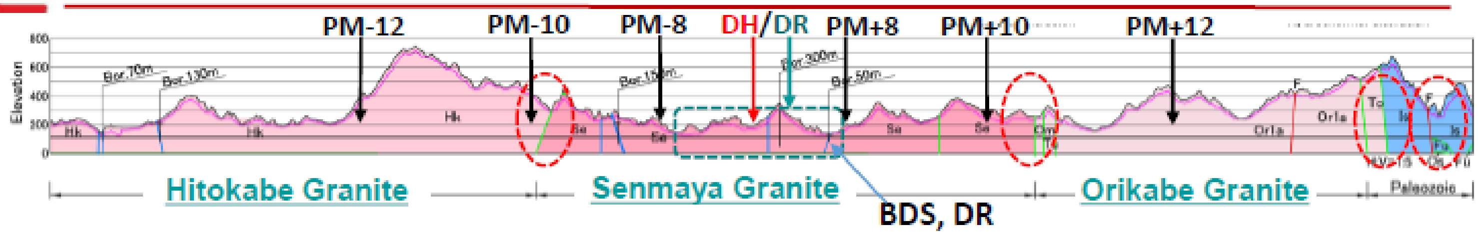
Geological Investigation



Survey Item		Survey Area									
		PM−12	PM−10	PM−8	DH	DR	PM+8	PM+10	PM+12	Others	Total
Surface Survey		○	○	○	○	○	○	○	○	○	-
	Q(Km2)	2	2	2	2	2	2	2	2	30	48
Geophysical Investigation		○	○	○	○	○	○	○	○	○	-
	Seismic Exploration	3	2	2	2	2	2	2	3	20	38
	Electro Magnetic Ex.	○	○	△	△	○	○	△	○	○	-
	Electric Prospecting	△	△	△	△	△	△	△	△	△	-
Boring Survey		○	○	○	○	○	○	○	○	○	-
	Vertical Boring No.	2	2	2	2	3	2	2	2	5	22
	Length (m)	300	350	150	150	200	100	200	350	200	-
	Quantity (m)	600	700	300	300	600	200	400	700	1,000	4,800
	Horizontal Boring	100	50	50	100	-	50	50	100	-	500
	Rock Examination	○	○	○	○	○	○	○	○	○	-

CFS planning for pre-construction period

- ***Proposed Site Investigation to allow construction tendering (M.Miyahara)***

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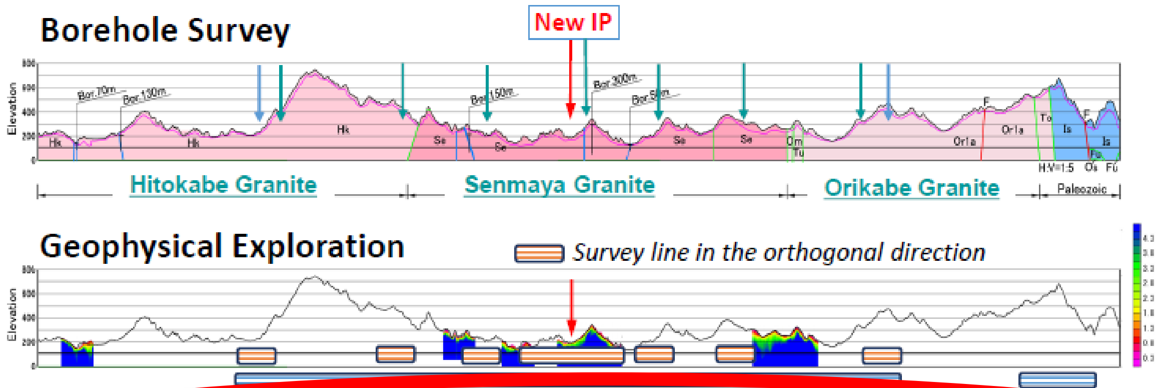
Geological Investigation

☐ Profiles of Geological Surveys along the project



Geological Survey plan at the pre-construction stage

	Preliminary study	Basic Design	Detailed Design
Borehole Survey	- 1 p IP area	- 8 p along the BL	- 13 p along the BL
Seismic exploration	- 2 km	- 18 km	- 18 km

Approx 1% of out-turn CFS civil estimate

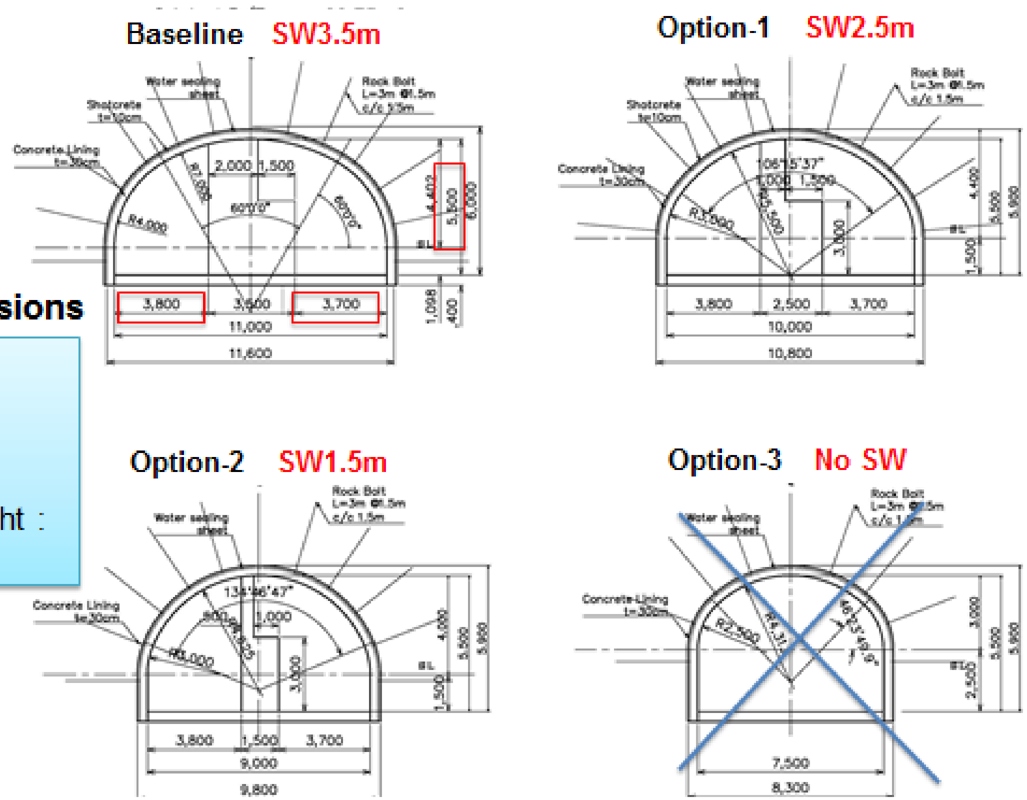
CFS and Main Linac radiation shielding (T.Sanami)

- ***Update of radiation simulations***
- ***TDR has 3.5m thick central shielding wall***

ML Tunnel Section variation

Common Dimensions

Beam line :
Width 3.8m
Klystron gallery:
Width 3.7m
Tunnel Inner height :
5.5m



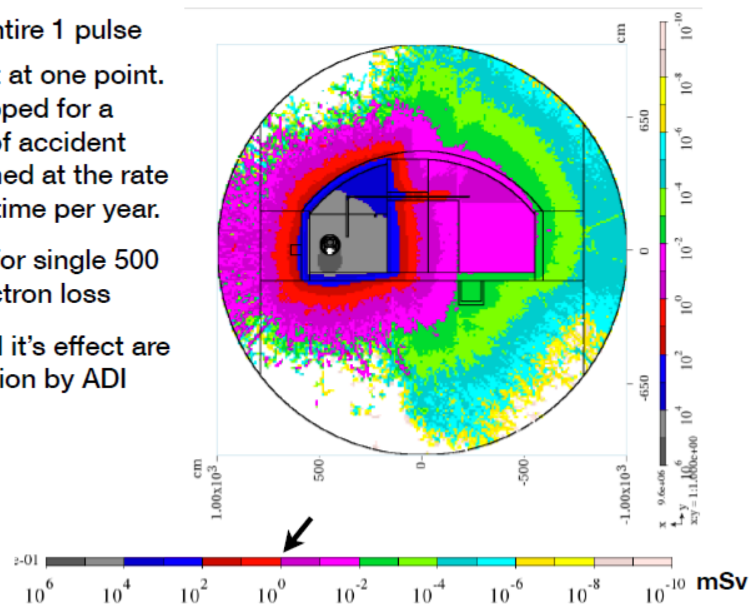
CFS and Main Linac radiation shielding

- *Initial findings show that a wall reduced to 2.5m thick could be sufficient*
- *Change control to be initiated with cost saving for smaller tunnel and wall*

LCWS2014 Oct/8/2014 9:00-9:30

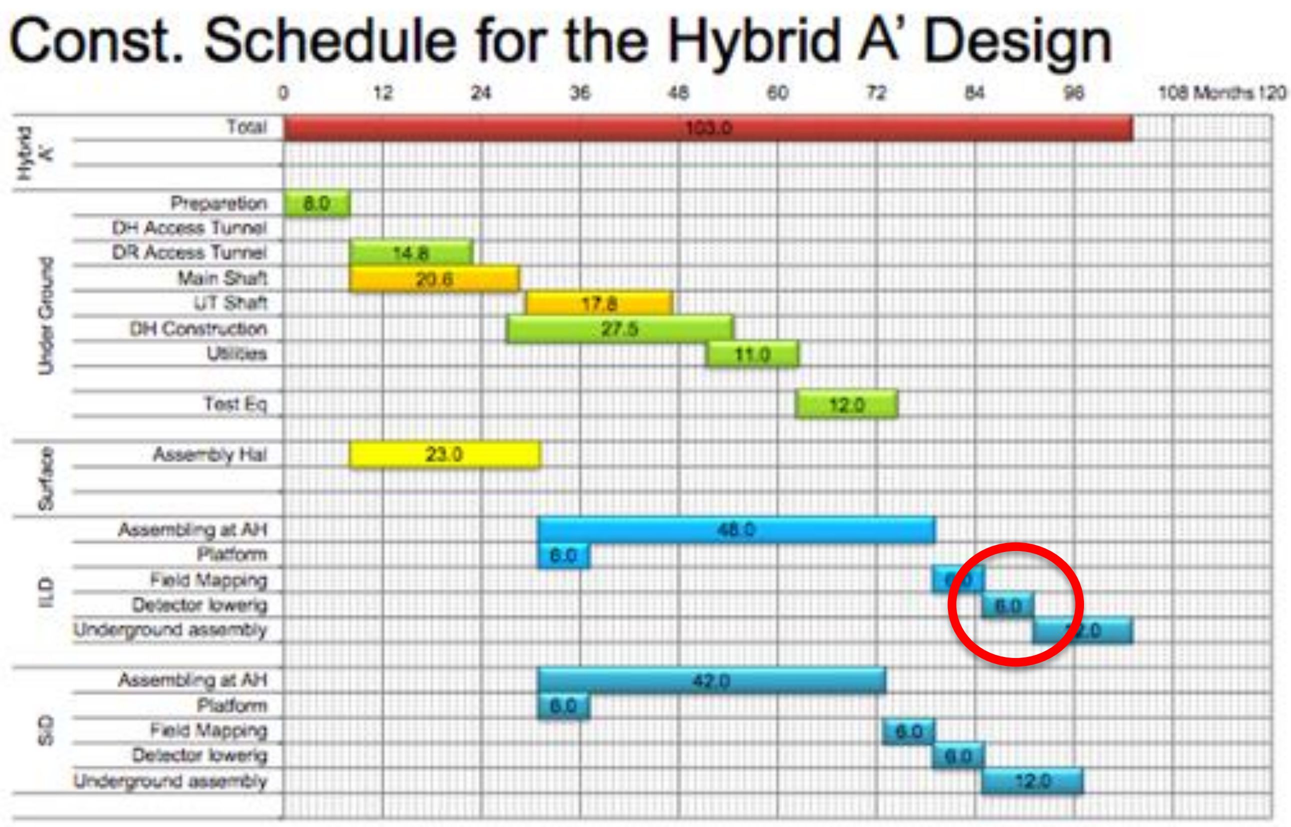
ML - dose rate at system failure

- (assumption) entire 1 pulse train beam is lost at one point. Operation is stopped for a while. This kind of accident would be happened at the rate of less than one time per year.
- Integrated dose for single 500 GeV 4.26e13 electron loss
- Failure mode and it's effect are under consideration by ADI team



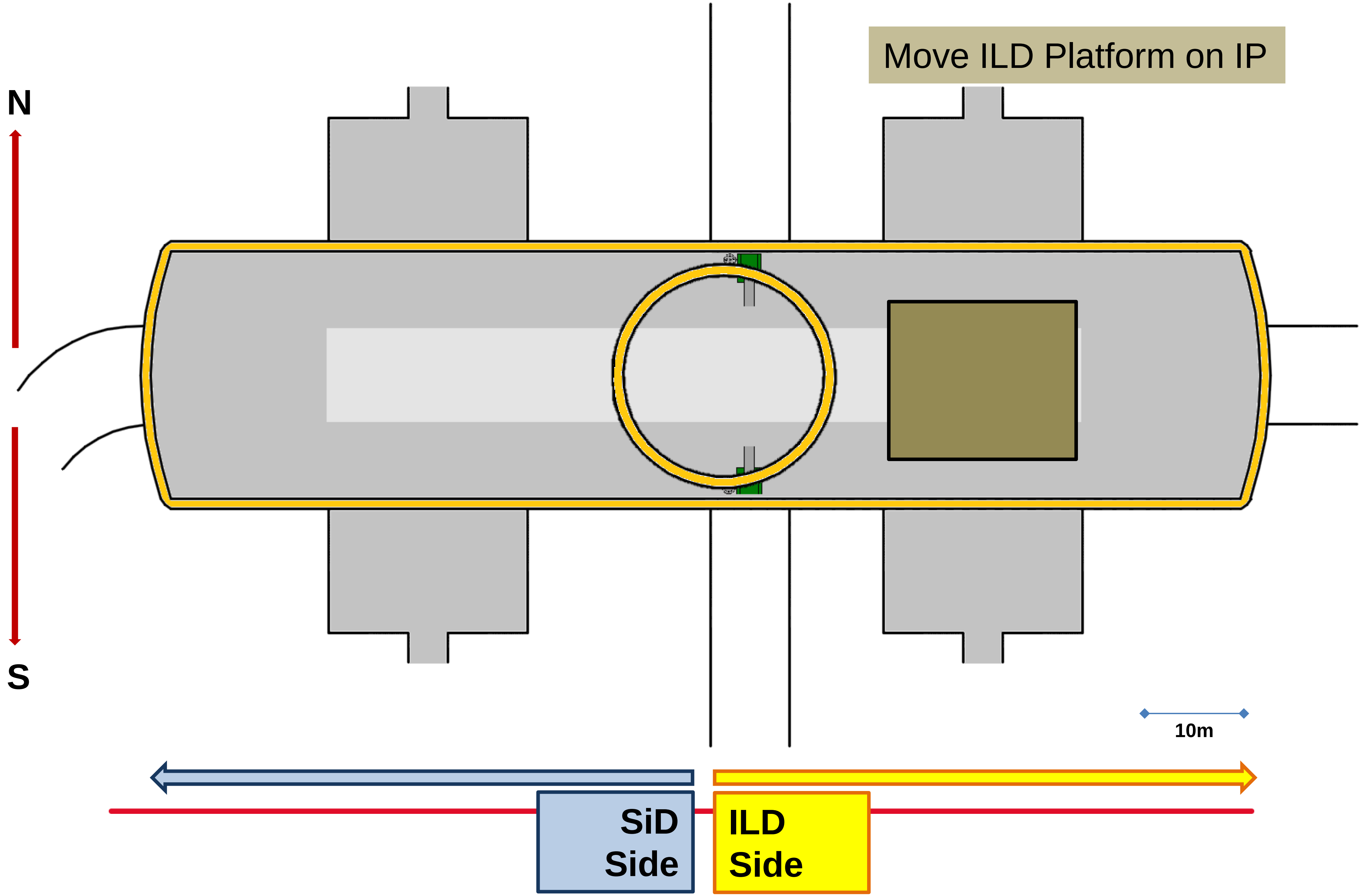
CFS – Detector and Machine Scheduling (M.Gastal)

- ***Detector Scheduling***
- ***CFS schedule prepared for IR change control :***

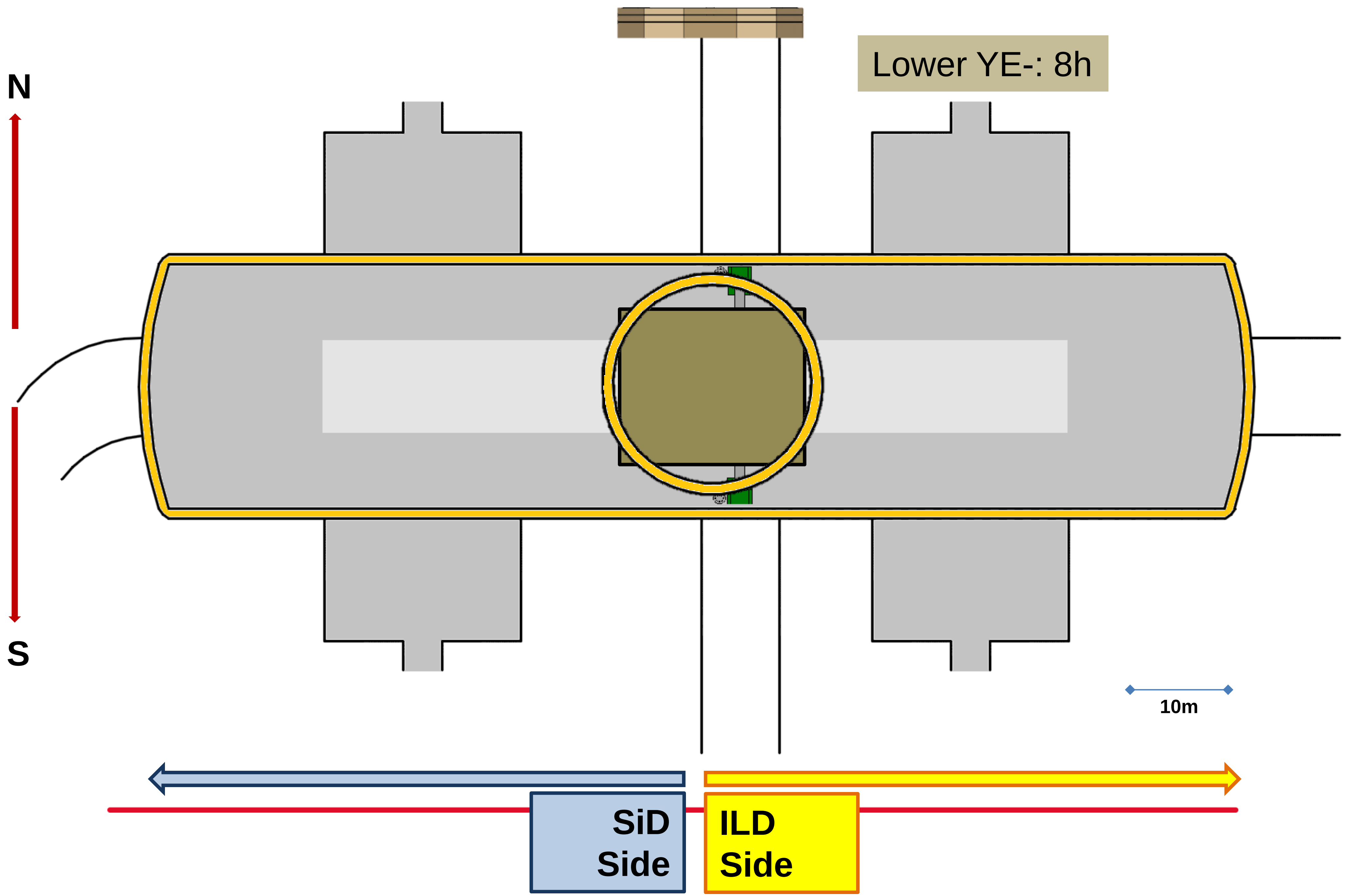


- ***Martin has started looking in more detail in the 6 months lowering period for ILD with detector colleagues***

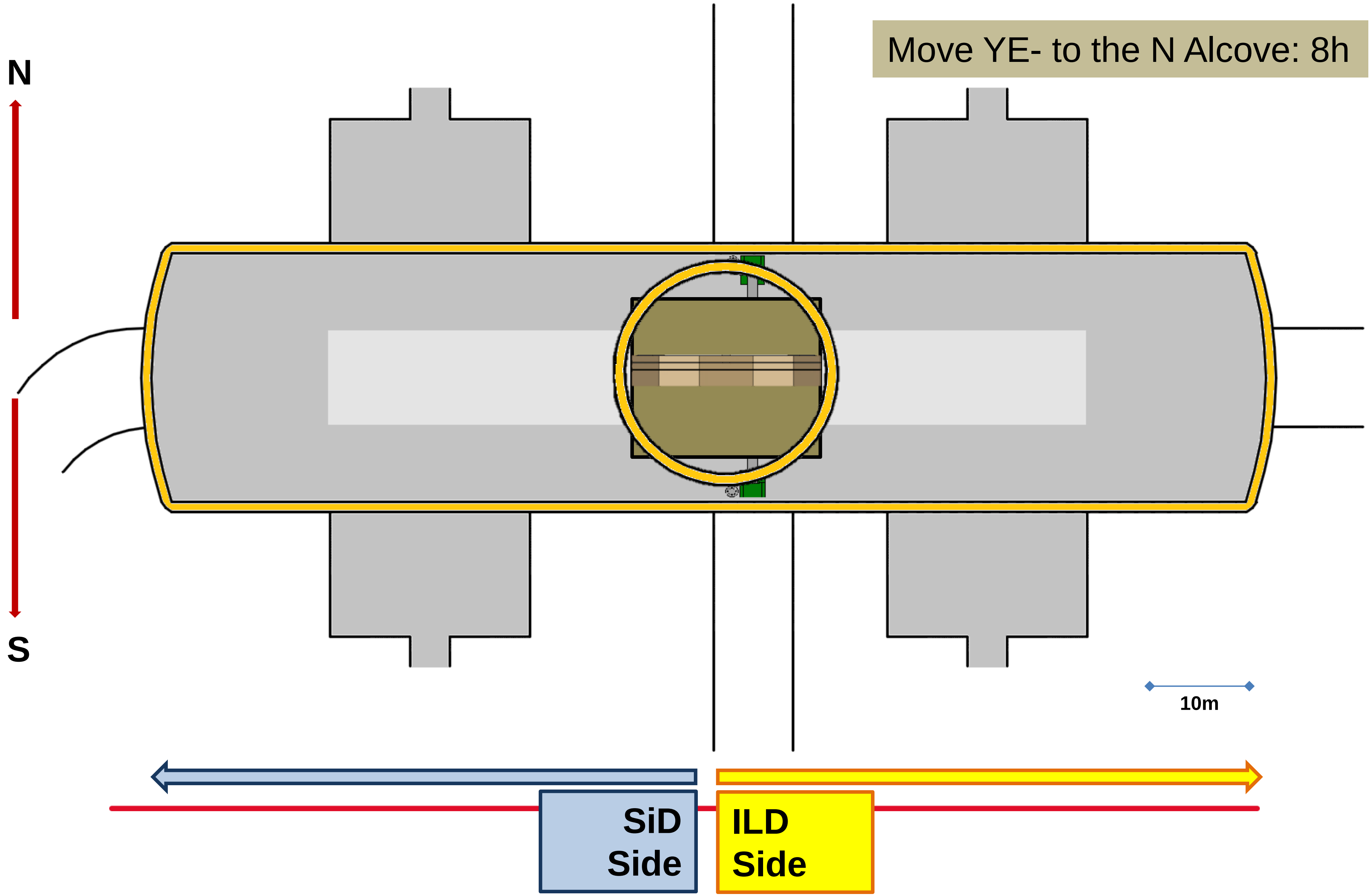
ILD Detector lowering sequence



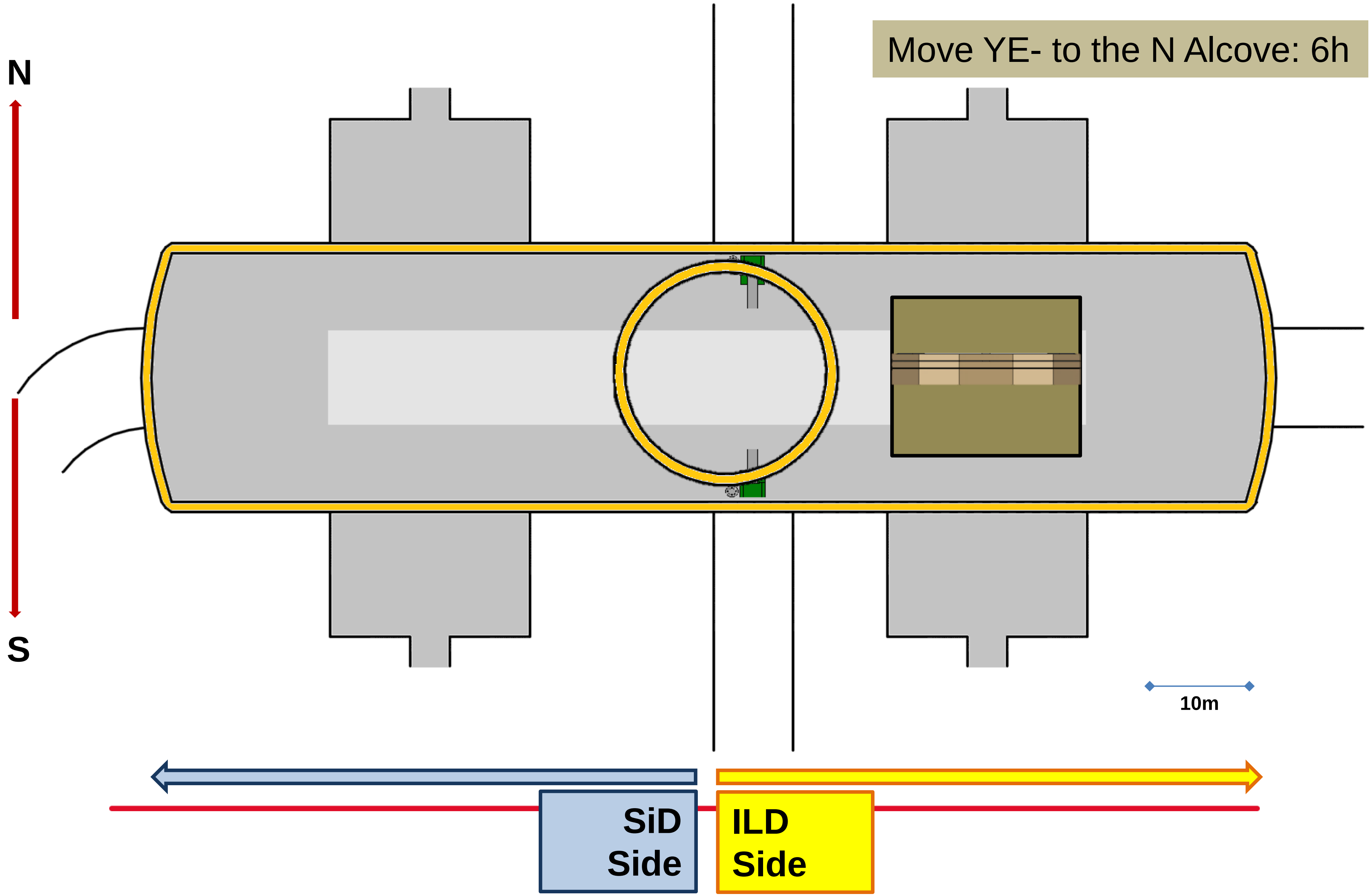
ILD Detector lowering sequence



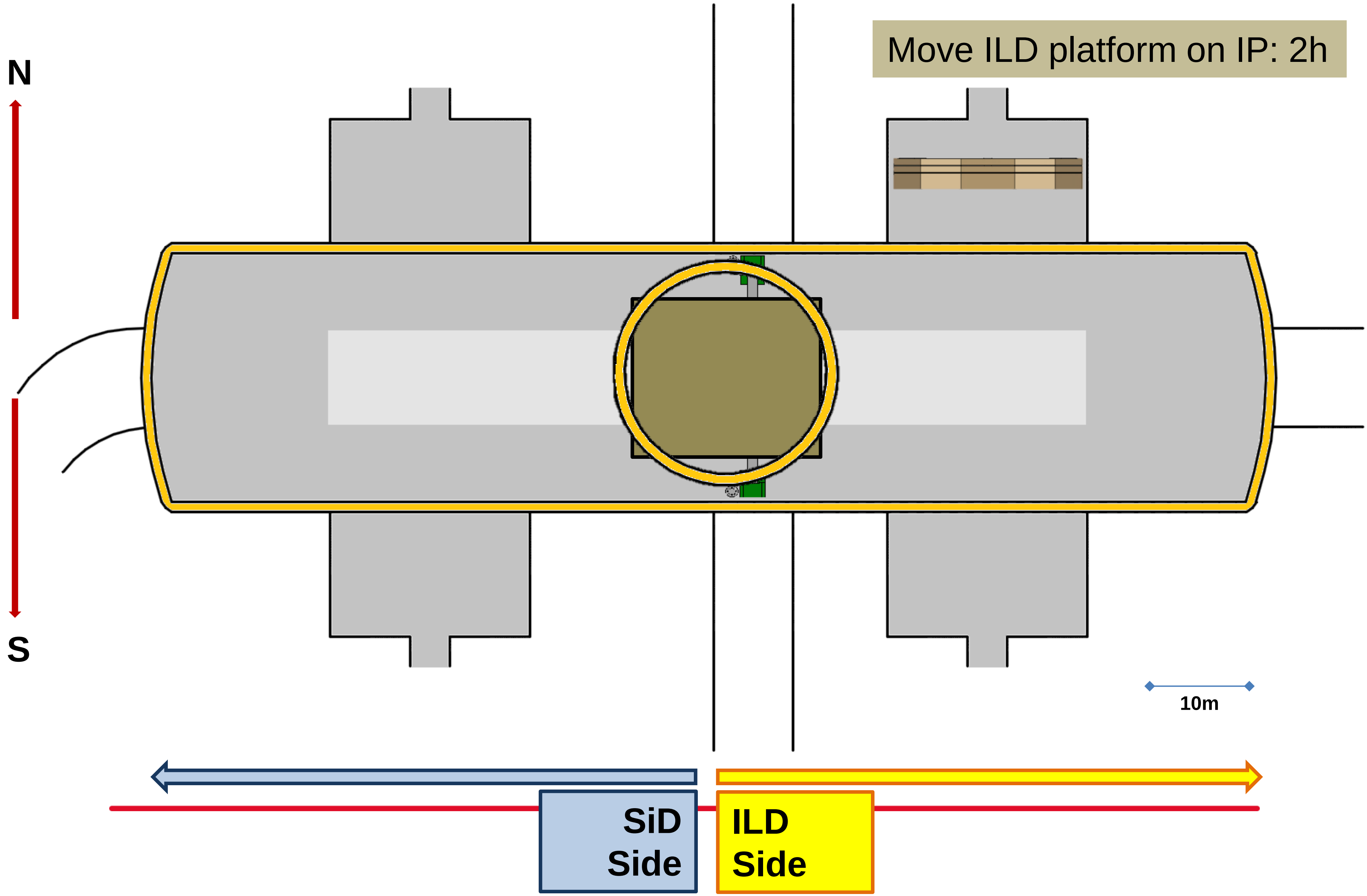
ILD Detector lowering sequence



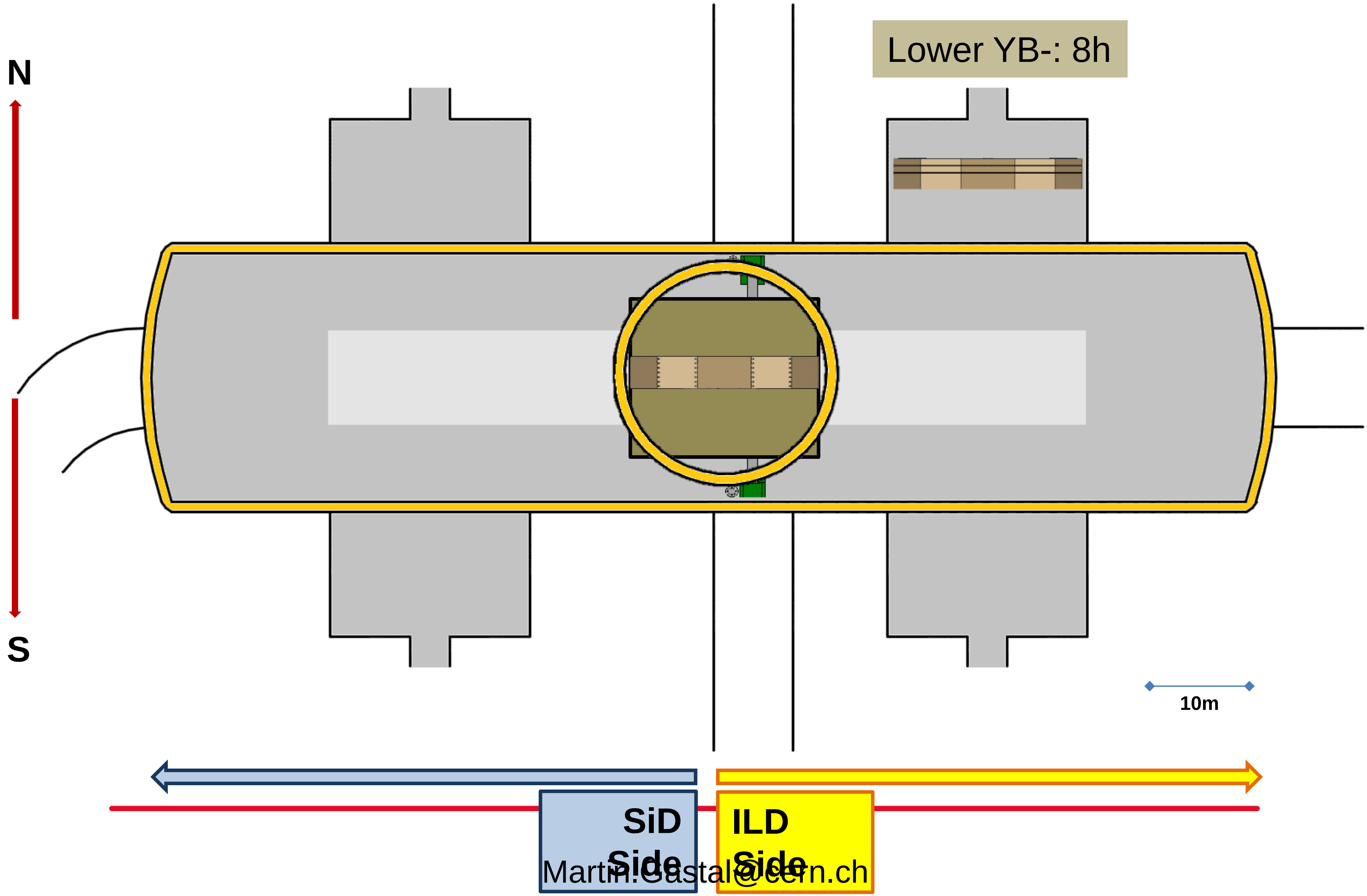
ILD Detector lowering sequence



ILD Detector lowering sequence

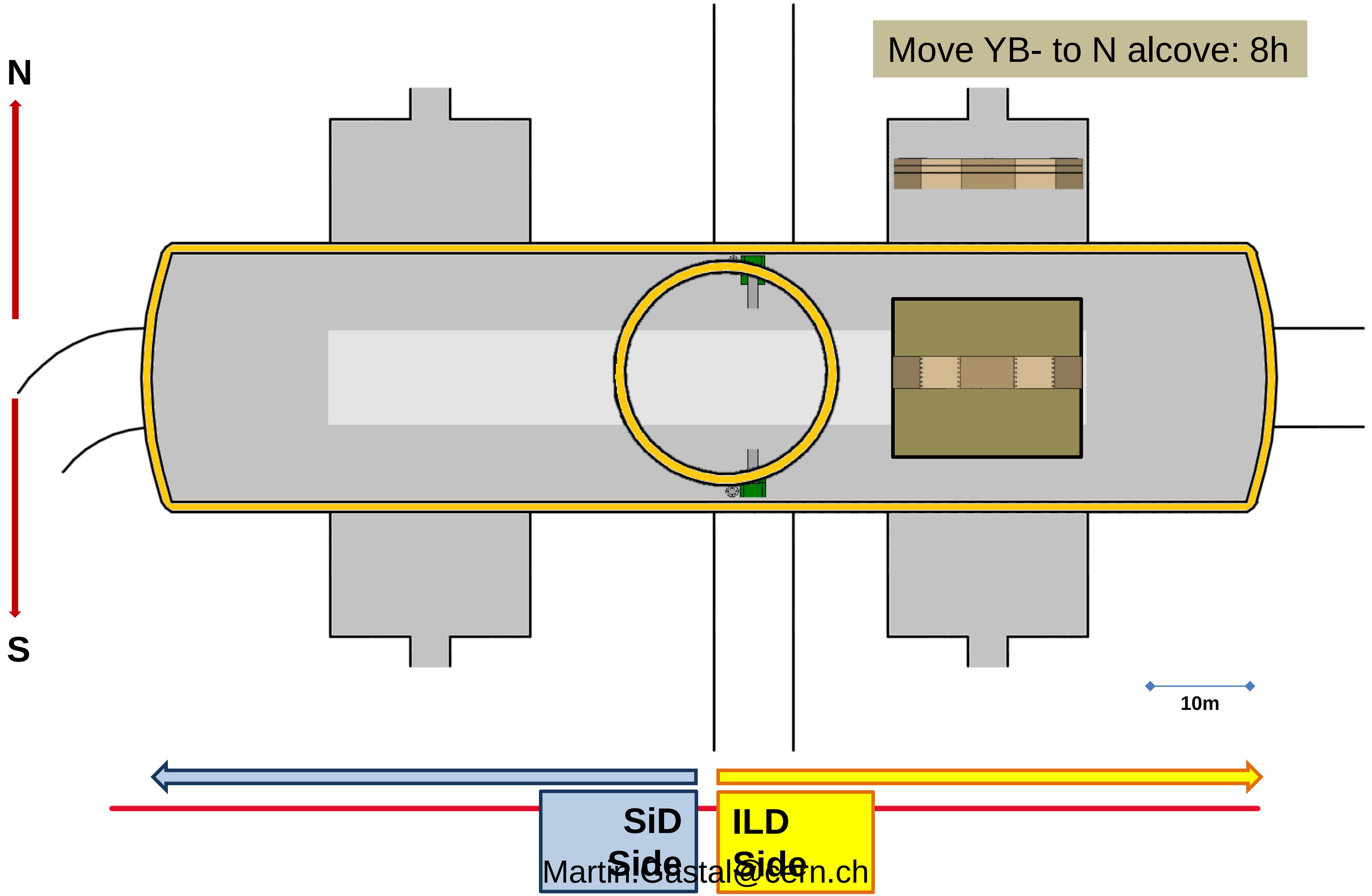


ILD Detector lowering sequence



Martin.Gastal@cern.ch

ILD Detector lowering sequence



Martin.Gastal@cern.ch

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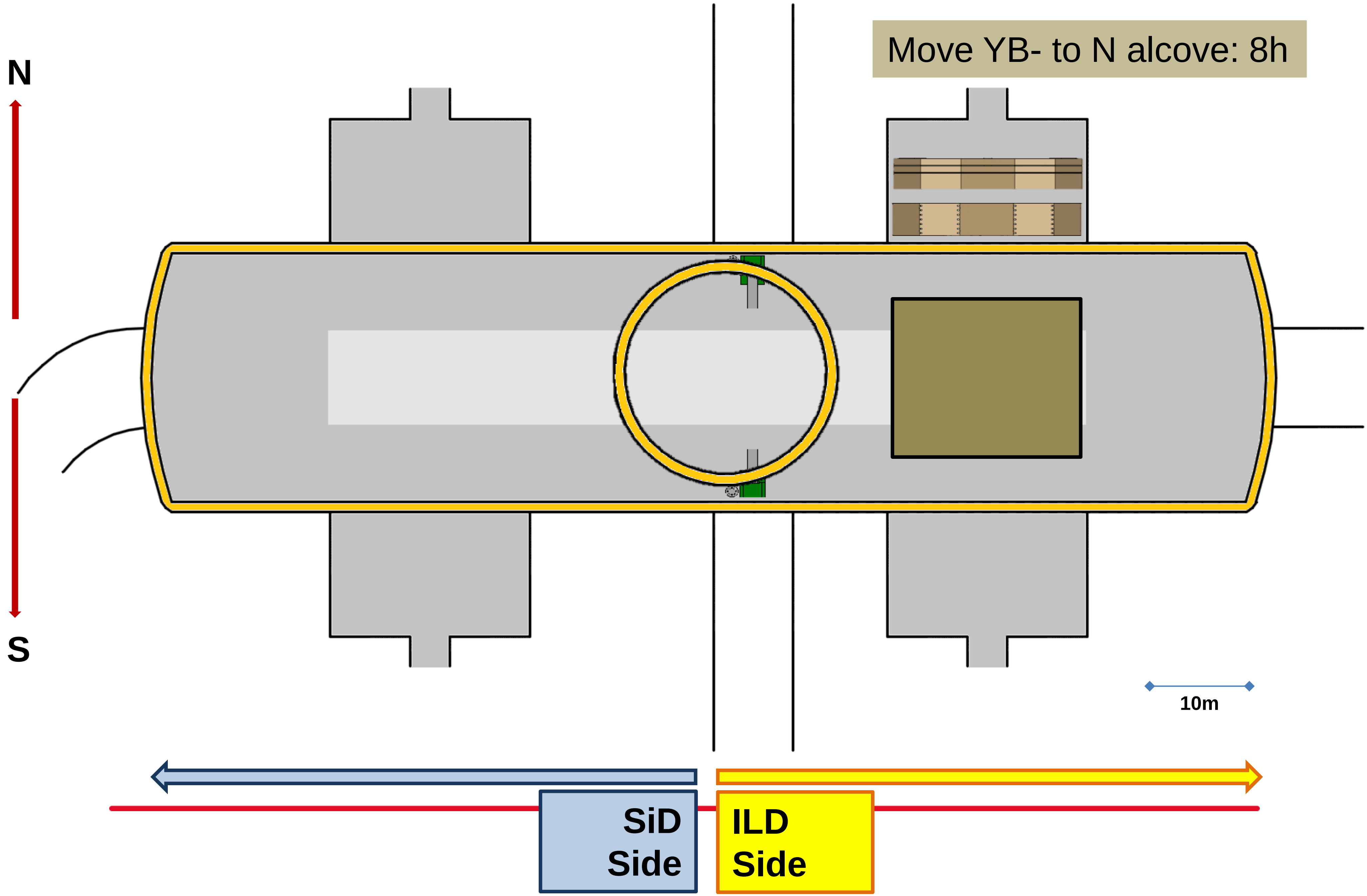
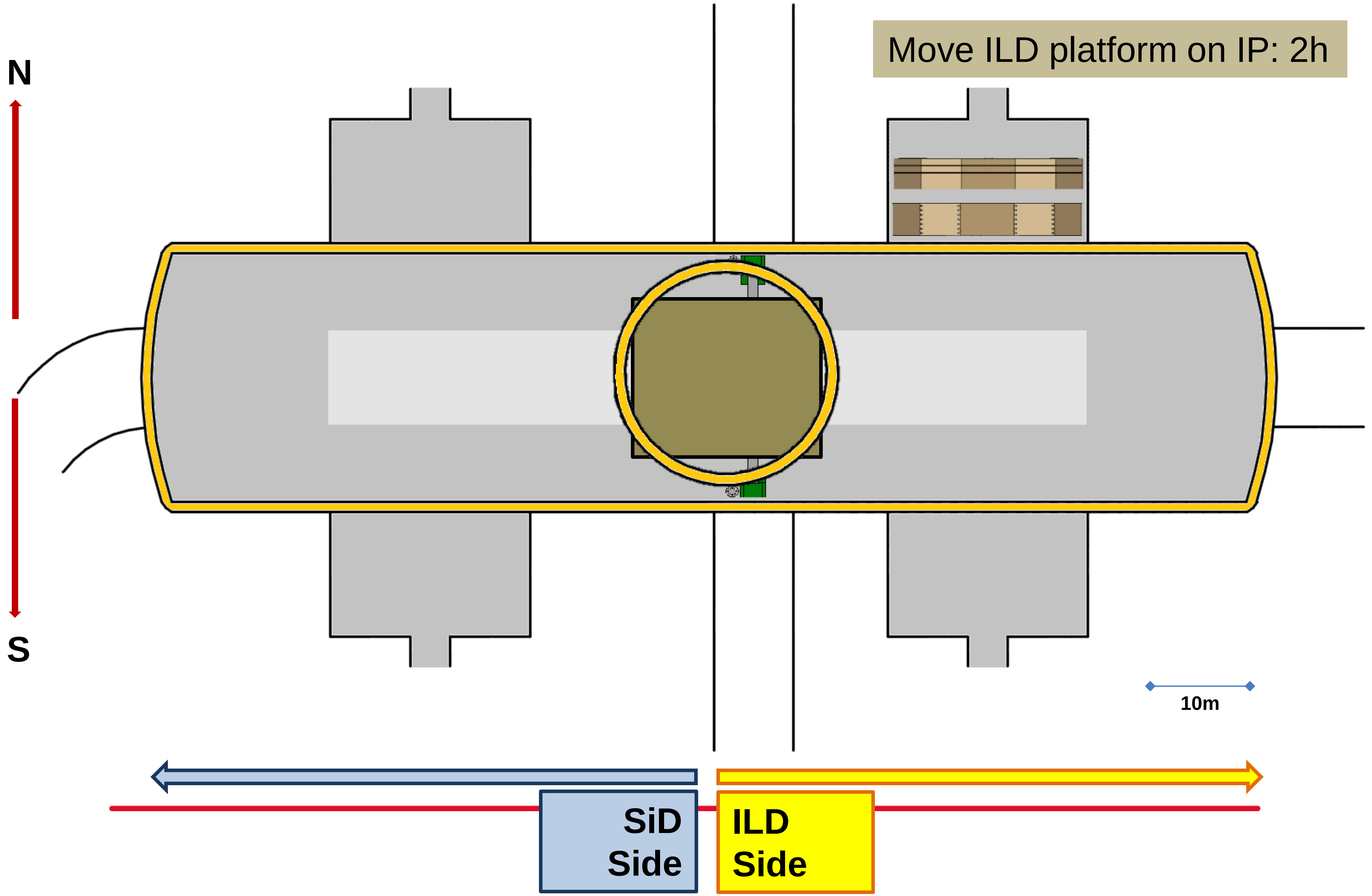
ILD Detector lowering sequence



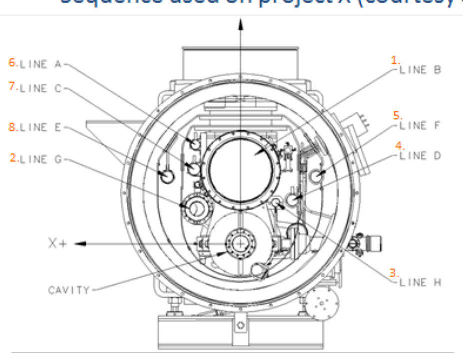
ILD Detector lowering sequence



CFS – Machine Scheduling (M.Gastal)

- *Machine installation rate has a critical impact on the overall ILC construction schedule*
- *Further to recommendations at Windsor Cost Review the rates are being re-visited*
- *Martin is contacting XFEL and Project X colleagues to update the installation schedule*

- Sequence used on project X (courtesy of Jerry Leibfritz)



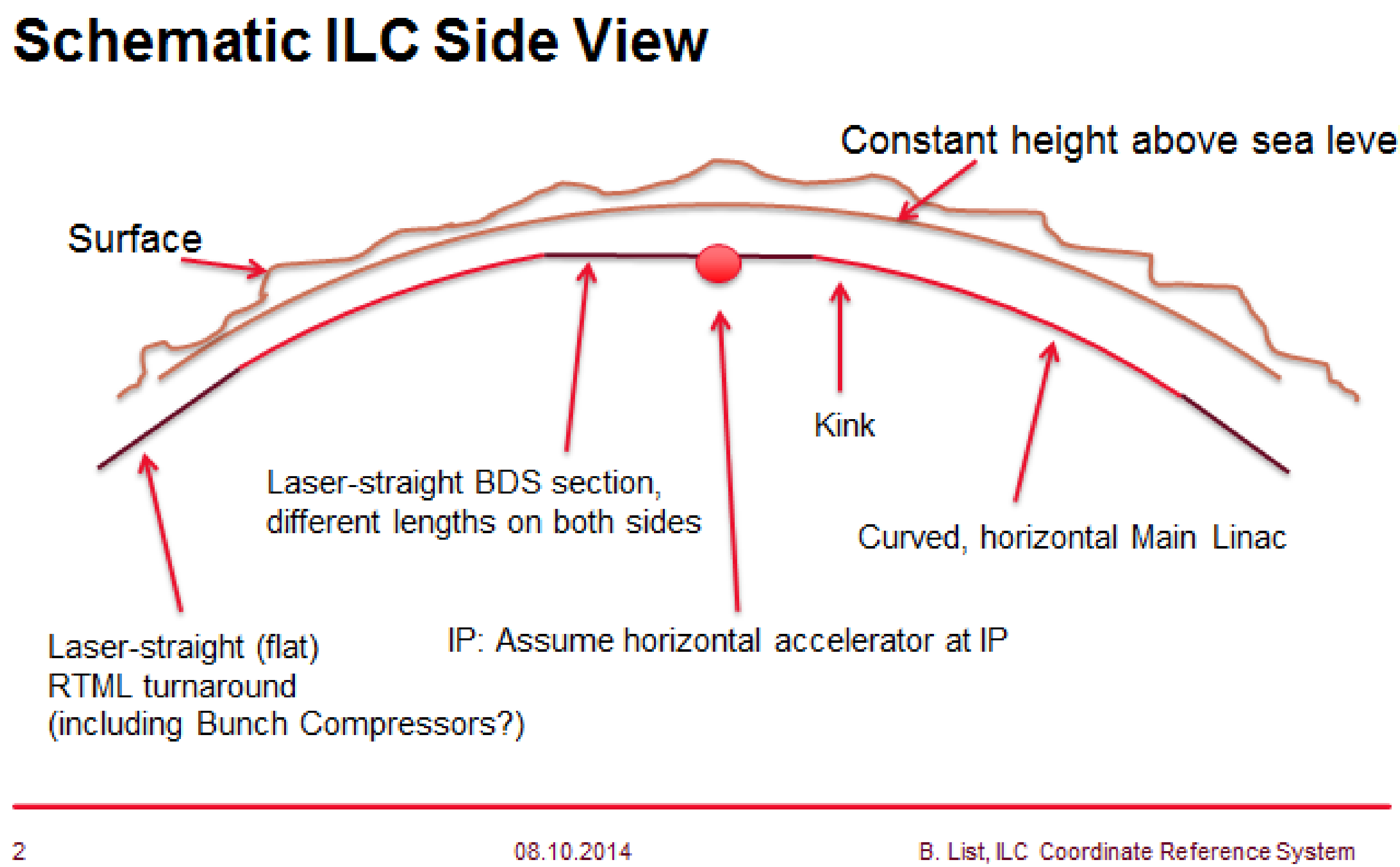
Cryogenic Line	Circuit description	T3PCM Pipes Coordiantes	
		X	Y
[-]	[-]	[mm]	[mm]
A	2K helium supply	219.0	481.5
B	Sub atmospheric helium return	0.0	356.0
C	5K Thermal shield supply	225.5	362.5
D	5K Thermal shield return	-252.0	212.0
E	80K Thermal shield supply	355.0	325.0
F	80K Thermal shield return	-367.0	326.0
G	Sub atmospheric helium supply	212.0	170.0
H	Cooldown/warmup	-170.0	200.0

Interconnect operation #

Figure 10.1. Upstream (bellows) end of cryomodule showing coordinate system.

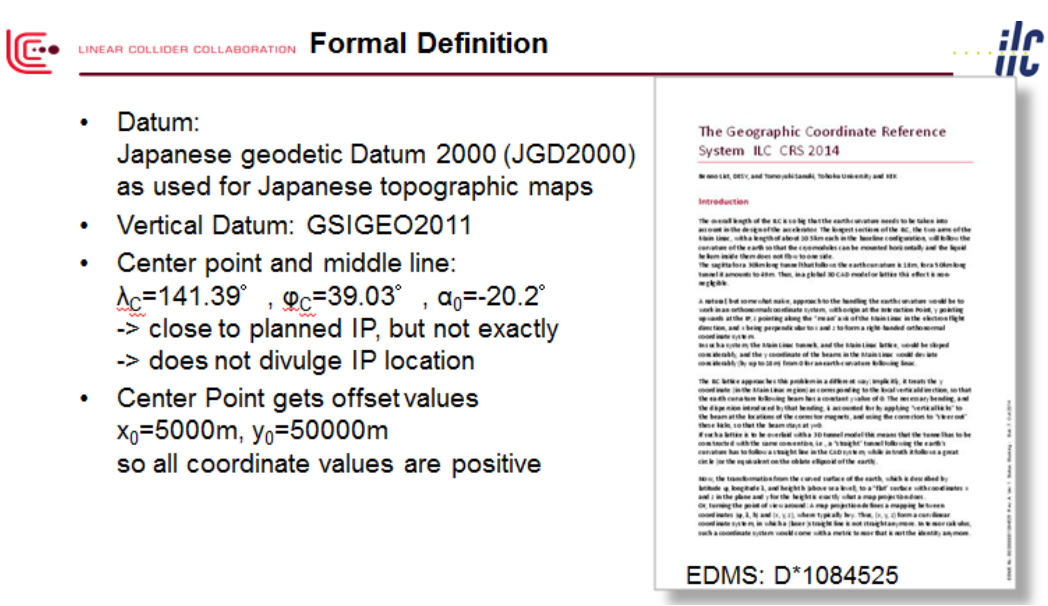
The ILC international cost review was carried out at Oakley Court in Windsor, UK, where the "Rocky Horror Picture Show" was filmed in 1975.

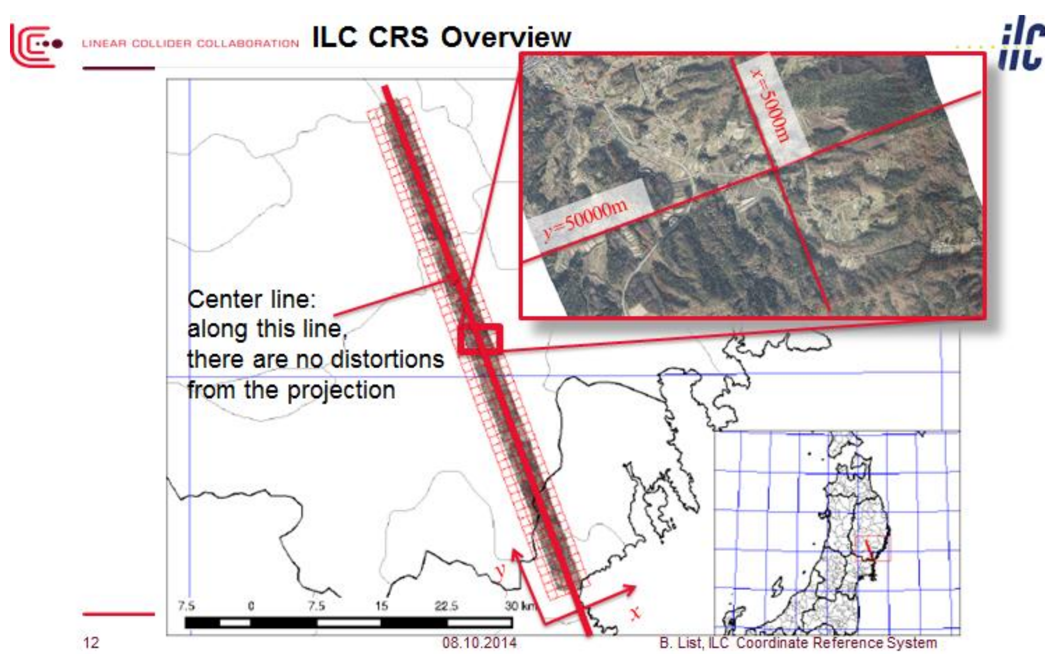
- ***"How to do design integration for a 30km long building" Benno***



CFS and ILC Coordinsate Reference System(B.List)

- Proposal from Benno for a standardised co-ordinate system
- Definition of an ILC CRS brings together geospacial data and CAD models, for use in GIS and CAD systems
- Needs to be reviewed by survey experts world-wide





CFS – Requirements Tables (L.Hagge)

- ***Reminder from Lars that project requirements should be recorded correctly***
- ***For example, IR requirements table is under preparation***

Post-Processing: Requirements Tables

- **Add context to requirements for later discussion: Rationale, justification, origin, status …**
  - Spreadsheet format – started to use for detector hall:

Requirements for the ILC Detector Hall

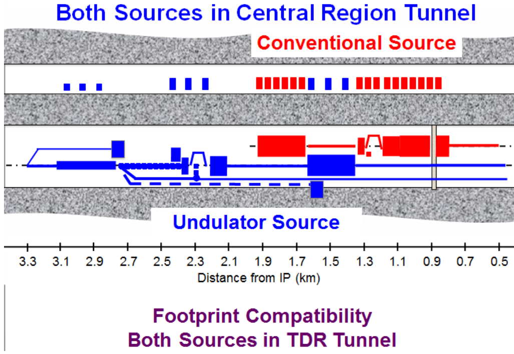
Title	Description	Rationale	Numerical Value	Justification	Building	Stakeholders	T
Magnetic Stray Field	The magnetic stray field at the IP caused by a detector in parking position must be less than	use of iron-based tools	50G	CMS experience, measurements at DESY	DH	Assembly	D
Magnetic Stray	The magnetic stray field around	functioning of detector near	2000G	unclear	DH	Safety	D

  - Aim: Keep track of why a requirement was raised by whom, in case questions arise during design

- **In the beginning, converting bulleted requirements lists to tables can be provided as a service by the DESY team**

CFS & Positron Source Joint Session (T.Omori)

- *Conventional Source being considered in addition to TDR 'rotating' system*
- *TDR design has two tunnels in central region*
- *Future studies needed to see if its cheaper to extend the 'standard' tunnel cross section through this area with local enlargements*
- *RDR had a shaft for radiation storage of targets onto surface, or should it be stored locally underground ?*
- *Needs to be studied further for Kitakami site*



CFS – Damping Ring civil design (M.Miyahara & G.Orukawa)

- ***Some changes were discussed for adapting the TDR design to the Kitakami mountain sIte, for example :***
- ***Damping ring access tunnel moved from TDR location to Hybrid A' position***
- ***Refuge areas in US design omitted and evacuation simulations***
- ***Tunnel Shape optimised for drill and blast***
  - ***Eg Kicker Areas re-modelled***
- ***Shielding wall currently 1m thick in DR***

Damping Ring Configuration for Asian Region in case of the Hybrid A' Option