

# Solenoid construction plan

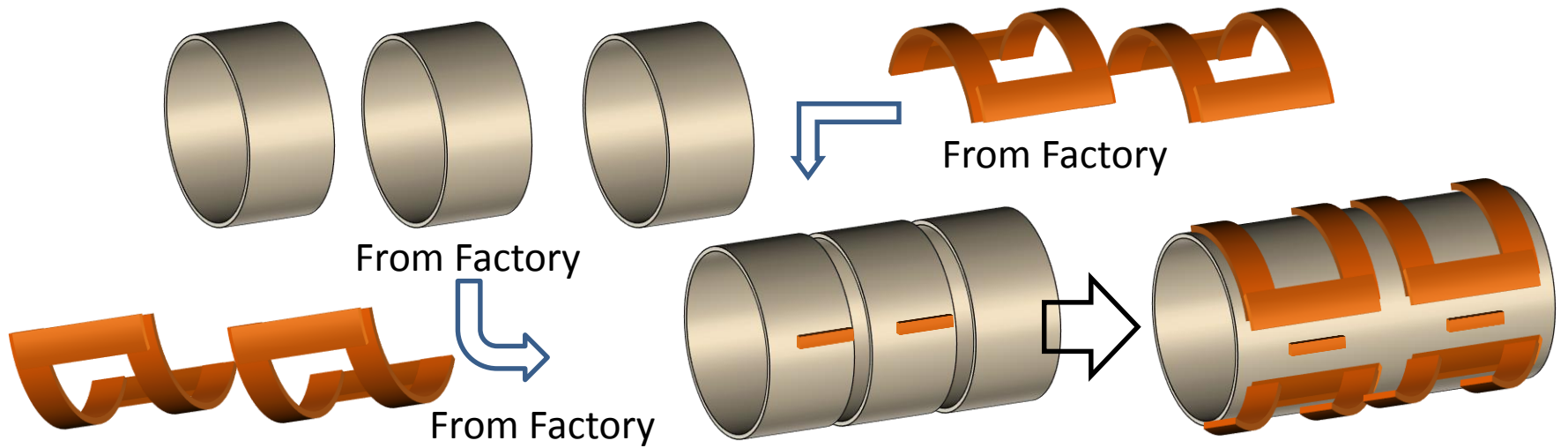
27.Oct.2019

Y. Makida

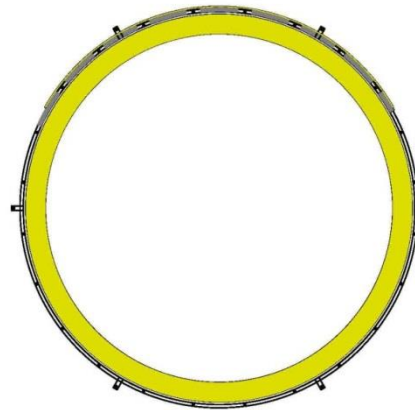
# Coil Dimensions and Solenoid Field

	TDR & HITACHI	TOSHIBA
Coil Inner Radius (mm)	3615	3215
Coil Outer Radius (mm)	3970	3570
Length (mm)	7350	7350
Each Block Length (mm)	2450	2450
Turn × Layer	309 × 4 300 × 4 (for gap b/w module)	330 × 5
Nominal Current (A)	22400 23072 (in case 300 turn )	15339
Current Density (A/mm <sup>2</sup> )	10.6	9.7
Central Field (T)	4.0	4.0
Maximum Field (T)	4.6	4.5
Support Shell Thickness (mm)	50 (Checked by ANSYS )	10 – 100 (now analyzing)

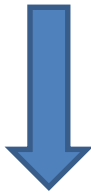
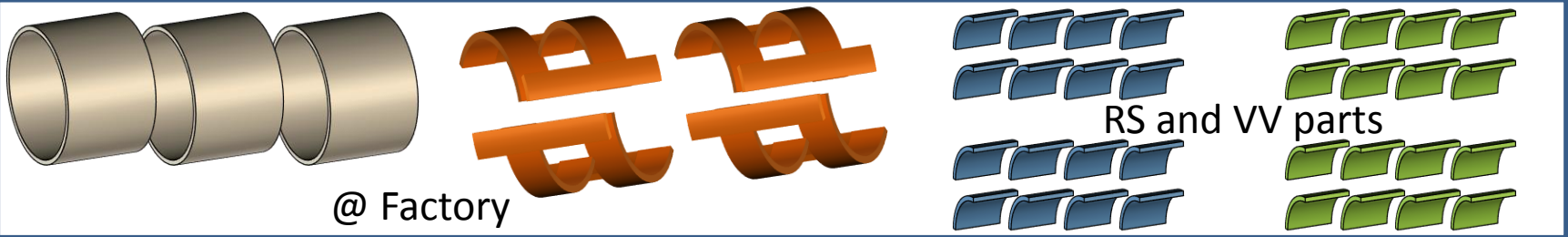
# Outline of ILD magnet manufacturing process



Solenoid Inner Radius (mm)	3615
Solenoid Outer Radius (mm)	3970
Solenoid Length (mm)	7350
Each Block Length (mm)	2450
Outer shell Thickness (mm)	50
Solenoid Weight (ton)	195
Each Block Weight (ton) <b>Trans.</b>	65 <b>90</b>
Anti DID Weight (ton) <b>Trans.</b>	3.6 <b>16</b>



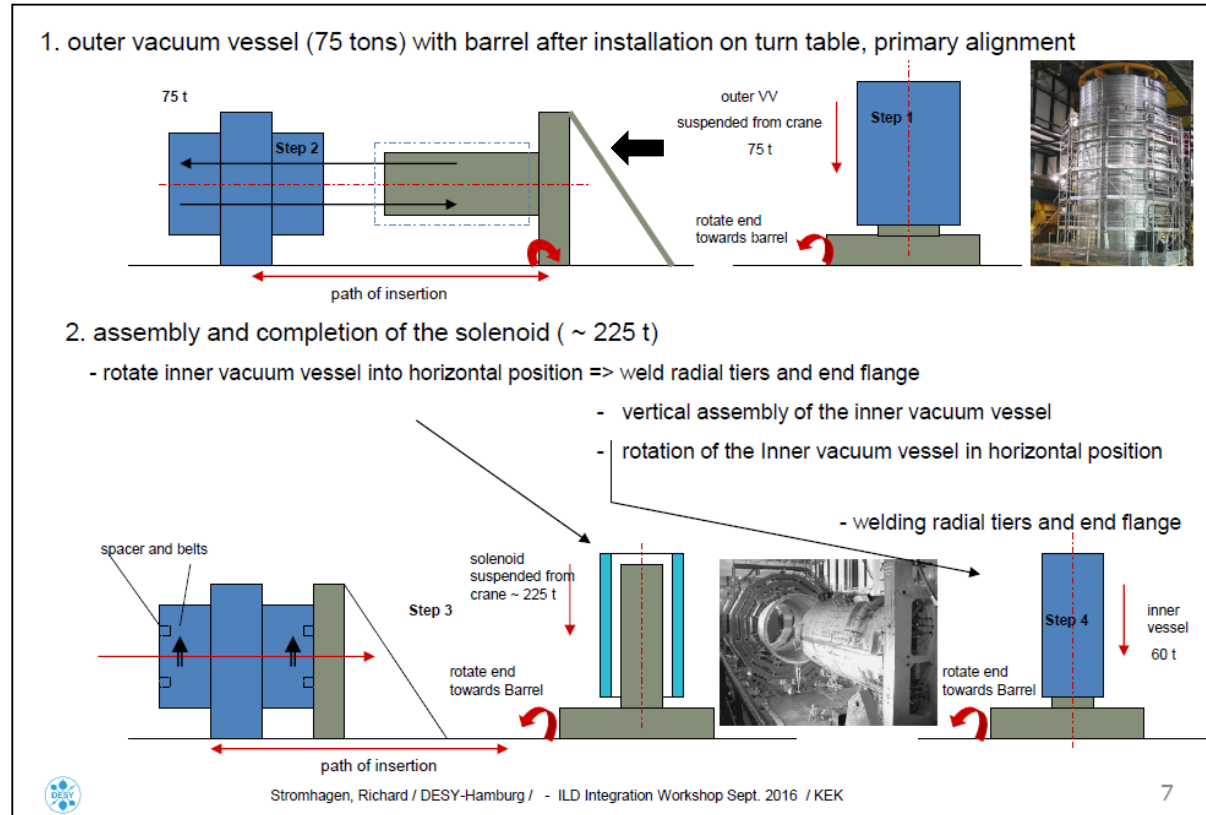
# Depot for Assembly



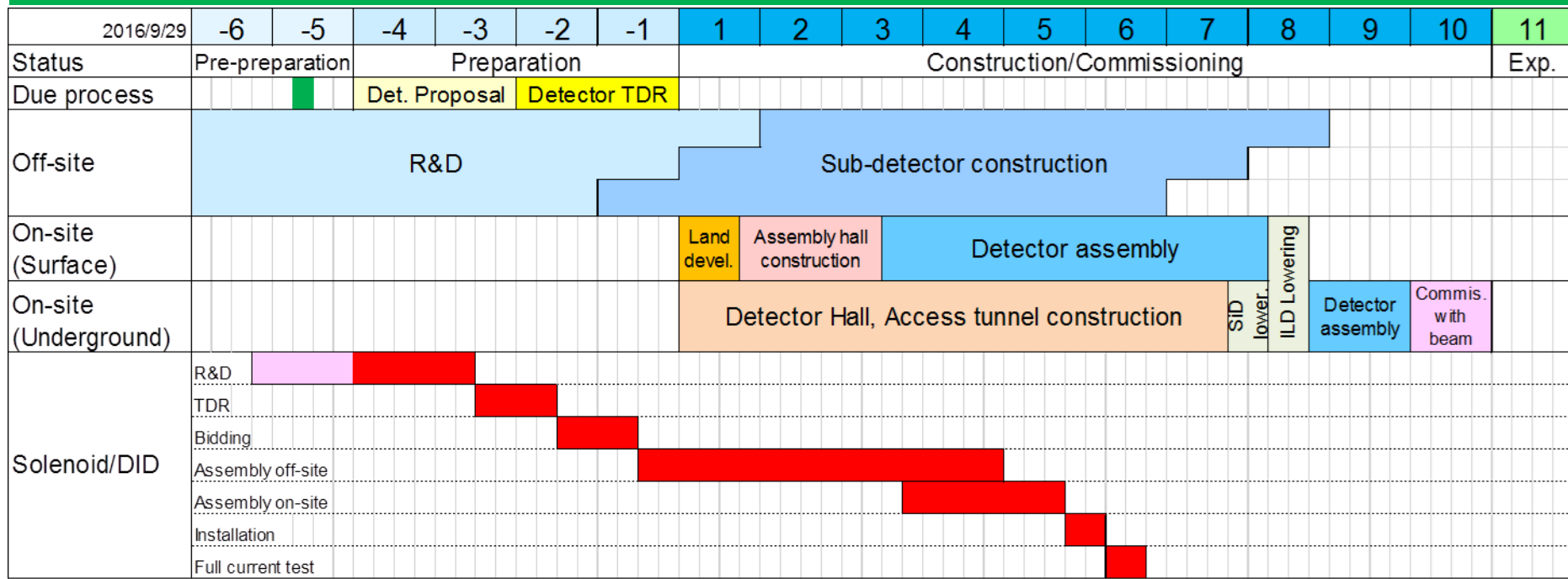
Depot facility

- Depots for Solenoid assembled units and parts.
- Send each units and parts to the assembly hall conveniently.
- Smaller assembly hall..

@ assembly hall



# Solenoid Manufacture Time Line



## R&D subjects before TDR

- ① Conductor Design
  - Manufacturable dimension
  - AL stabilizer material
- ② Technological components
  - Internal multilayer winding
  - Aluminum pipe welding
  - Conductor joint

## Assembly off-site (in Factories)

- ① 3 solenoid coil units (**Cold Mass**)
- ② 4 anti-DID coils (**Cold Mass**)
- ③ Several **Radiation Shield** units
- ④ Several **Vacuum Vessel** units

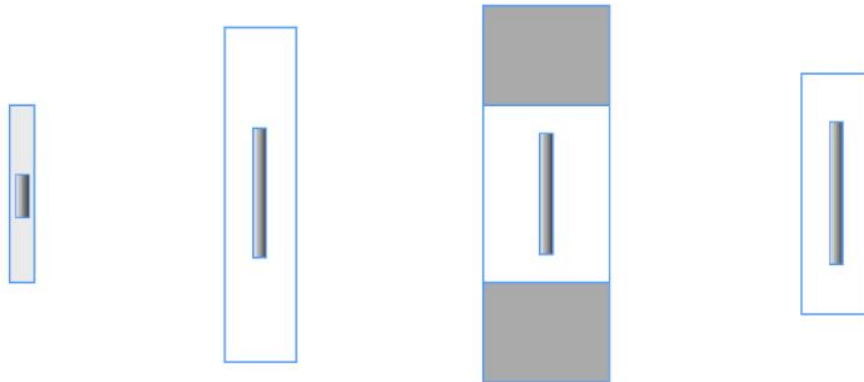
## Assembly on-site

- ① Completion CM, inner & outer RS and inner & outer VV
- ② Composition CM, RS , VV and Yoke

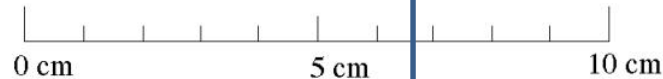
# R&D Conductor Design

## Cross Sections of Al Stabilized Superconductor in LHC detectors and R&D

Atlas CS      Atlas BT      CMS      Atlas ECT

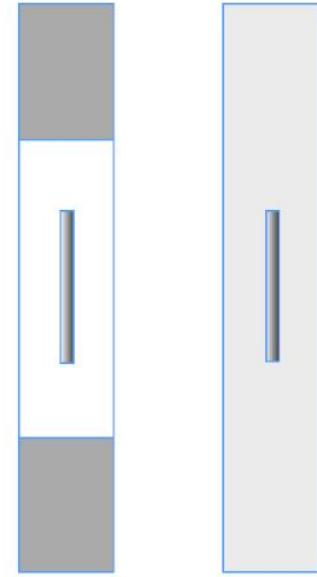


- Rutherford SC cable
- Pure Al stabilizer
- Reinforced Al stabilizer
- AA reinforcement



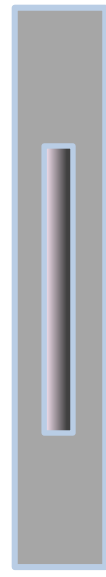
This dimensions is too larger to be manufactured by co-extrusion process.

5T, 5 layer  
18kA, 40 strand cable



Cu/NbTi Ratio : 1~1.3

New Proposal



Cu/NbTi Ratio : 6  
Rutherford Cable  
clad with Aluminum  
Alloy

**BUCK UP**

# ILD requirement for AH

by Sugimoto 2016

- Space
  - ILD needs assembly space for 5 yoke rings and solenoid
  - If we assume 25mx10m space for each of  $YE_{\pm}$  and  $YB_{\pm}$ , and 25x20m for  $YB_0$  and solenoid, respectively, 25mx80m space is necessary
- Crane
  - A 250 ton crane for yoke assembly and an 80 ton crane for solenoid/detector assembly and installation are needed
  - ~4000 ton gantry crane for detector lowering
- Hall height
  - 22.6m from the floor to crane rail, 6m from crane rail to ceiling, plus alpha for lights and fans on the ceiling
- Cryogenics
  - He gas pipes have to be connected from the compressor building for magnetic field mapping in AH
- Platform
  - ILD should have its own platform on surface to avoid the risk of delay of SiD construction

