



Plans for Prototype and Series for D1

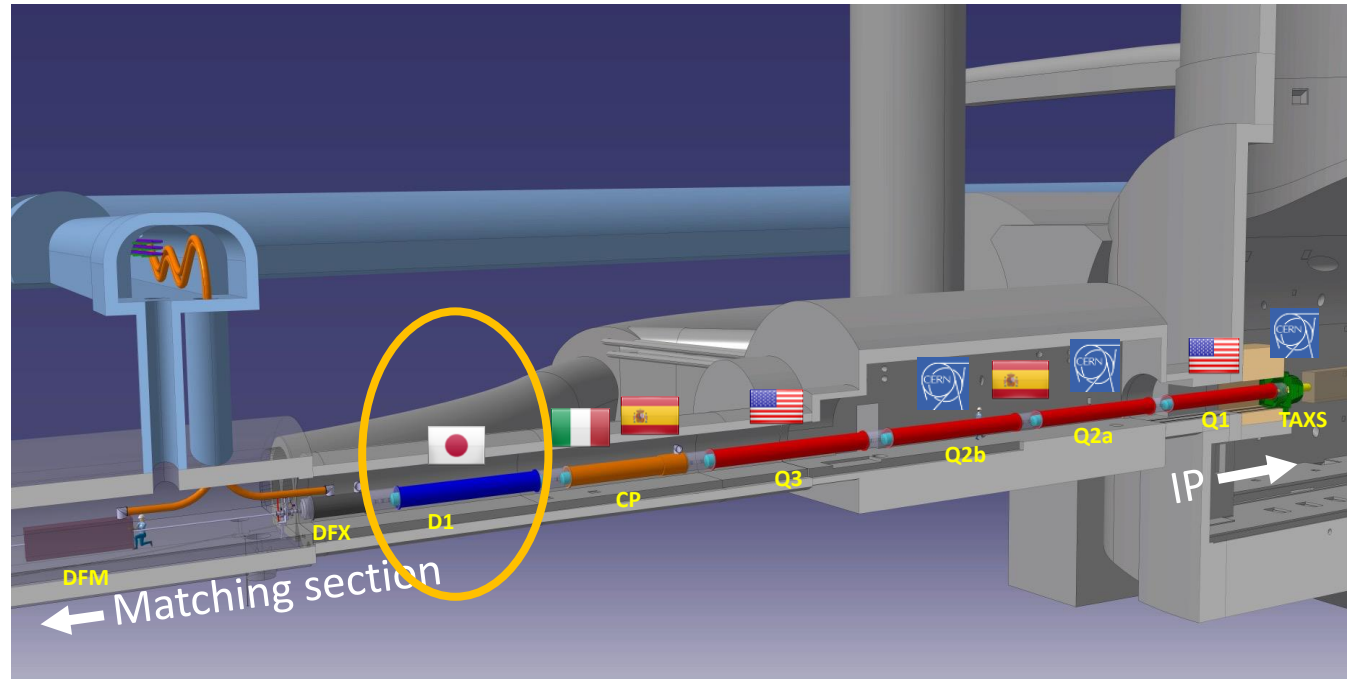
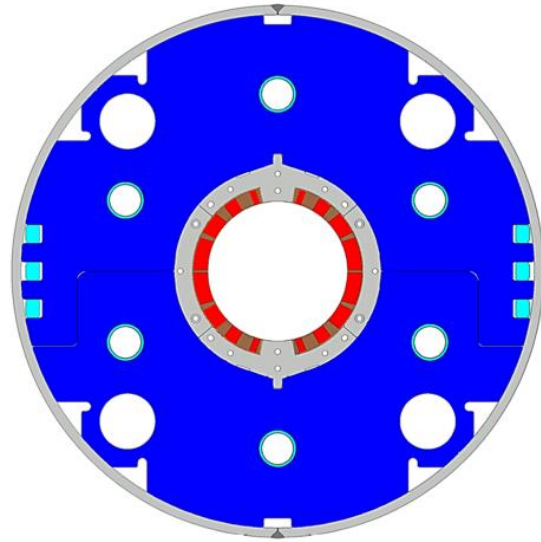
Tatsushi NAKAMOTO (KEK)

KEK

**On behalf of CERN-KEK Collaboration for D1 Development for
HL-LHC**

8th HL-LHC Collaboration Meeting, CERN, Oct. 18, 2018

Japanese Contribution to HL-LHC: D1 magnets



- Beam separation dipole (D1) by KEK
 - Design study of D1 for HL-LHC within the framework of the CERN-KEK collaboration since 2011.
 - 150 mm single aperture, 35 Tm (5.6 T x 6.3 m), Nb-Ti technology.
 - Development 2-m long model magnets (3 units) at KEK
- Deliverables for HL-LHC
 - *1 full-scale prototype cold mass (MBXFP)*
 - *6 series cold masses (MBXF1-6)*

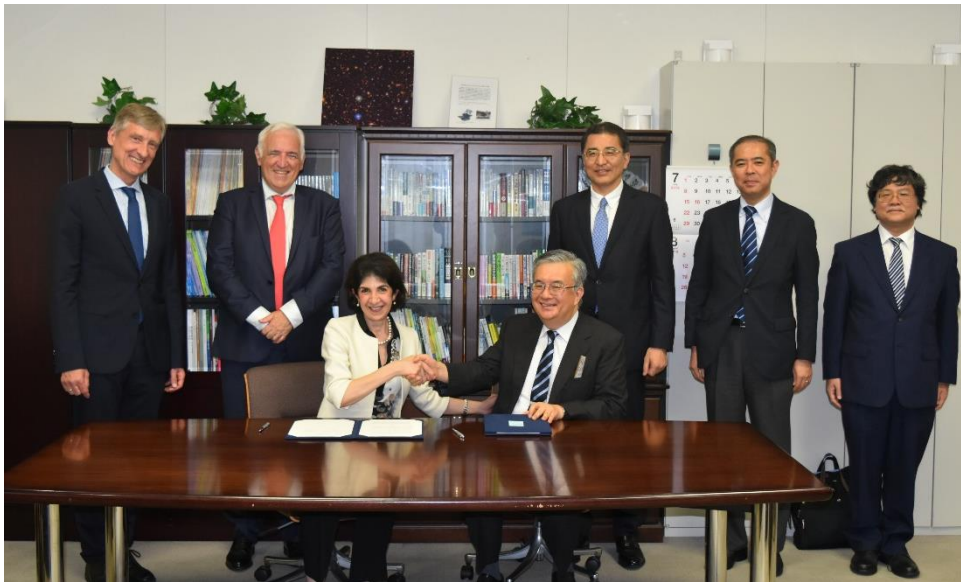
7 x 7-m long magnets

MOU's were signed on July 6, 2018 at MEXT, Tokyo, in presence of Dr. Isogai, Director General of Research Promotion Bureau, MEXT.

**MEMORANDUM OF UNDERSTANDING
FOR COLLABORATION IN THE HIGH LUMINOSITY LHC PROJECT
AT CERN**

BETWEEN: THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (“CERN”), an Intergovernmental Organization having its seat at Geneva, Switzerland, as the Host Organization of the High Luminosity LHC project (“HL-LHC Project”);

AND: THE INSTITUTES, LABORATORIES, UNIVERSITIES AND THEIR FUNDING AGENCIES AND OTHER SIGNATORIES OF THIS MEMORANDUM OF UNDERSTANDING,



KN4074/TE/HL-LHC

ADDENDUM

to

**THE MEMORANDUM OF UNDERSTANDING FOR COLLABORATION IN THE HIGH
LUMINOSITY LHC PROJECT AT CERN**

between

**THE INTER-UNIVERSITY RESEARCH INSTITUTE CORPORATION,
HIGH ENERGY ACCELERATOR RESEARCH ORGANIZATION (KEK)**

and

THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (CERN)

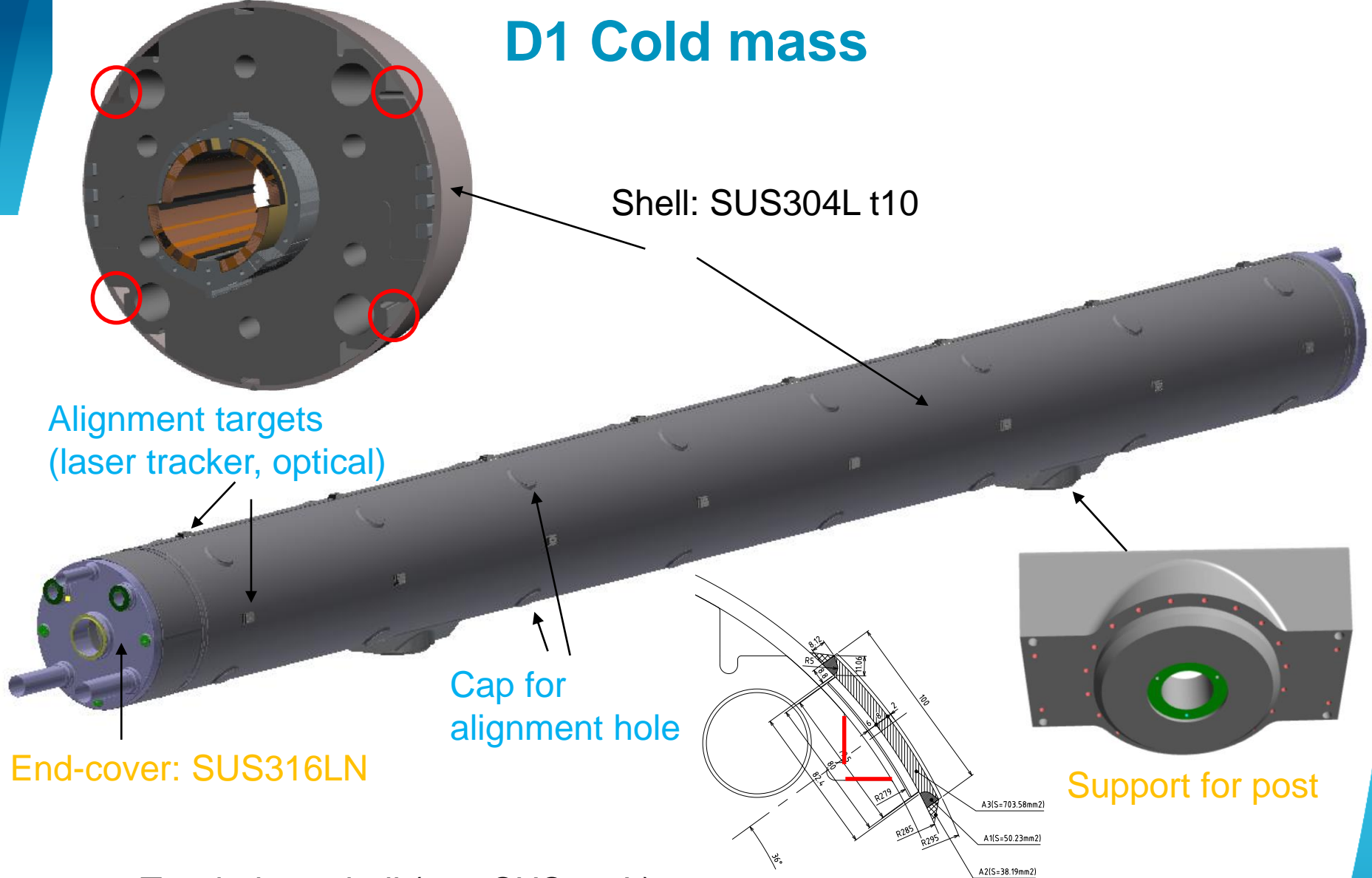
concerning

**Collaboration in the construction of the superconducting separation dipole magnet D1 in the
framework of the High Luminosity upgrade for the LHC at CERN**

Overview of Production of D1 Prototype and Series

- In-house development of 2-m model magnets so far.
 - Drawings of magnet are available. Preparation for 7-m magnets have started.
 - ✓ **Fine tuning of wedges and end-spacers only after MFM of the 2nd model.**
 - Fine-blanking dies for collar and yoke are developed and are ready for production.
 - 50% of stainless steel (NSSC130S) for the whole project already procured.
- **Production of 7-m magnets (cold masses) by a manufacturer. Contract will be given at April 2019.**
 - Involvement of industry already from model magnet development: smooth technical transfer, accurate (lower) cost estimate.
 - Most of tools will be prepared by the manufacturer.
- **Very tight time frame for the prototype cold mass: April 2019 to Dec. 2020.**
 - Procurement of coil winding machine in 2018
- Raw materials procured by KEK: timely provision to the manufacturer.
 - Low cobalt iron and stainless steel, radiation resistant GFRP.
- Supplies from CERN: insulated SC cables, laminates of QPH (to be paid), HX tubes, insulated beam tubes (to be paid), end-covers (under discussion).

D1 Cold mass

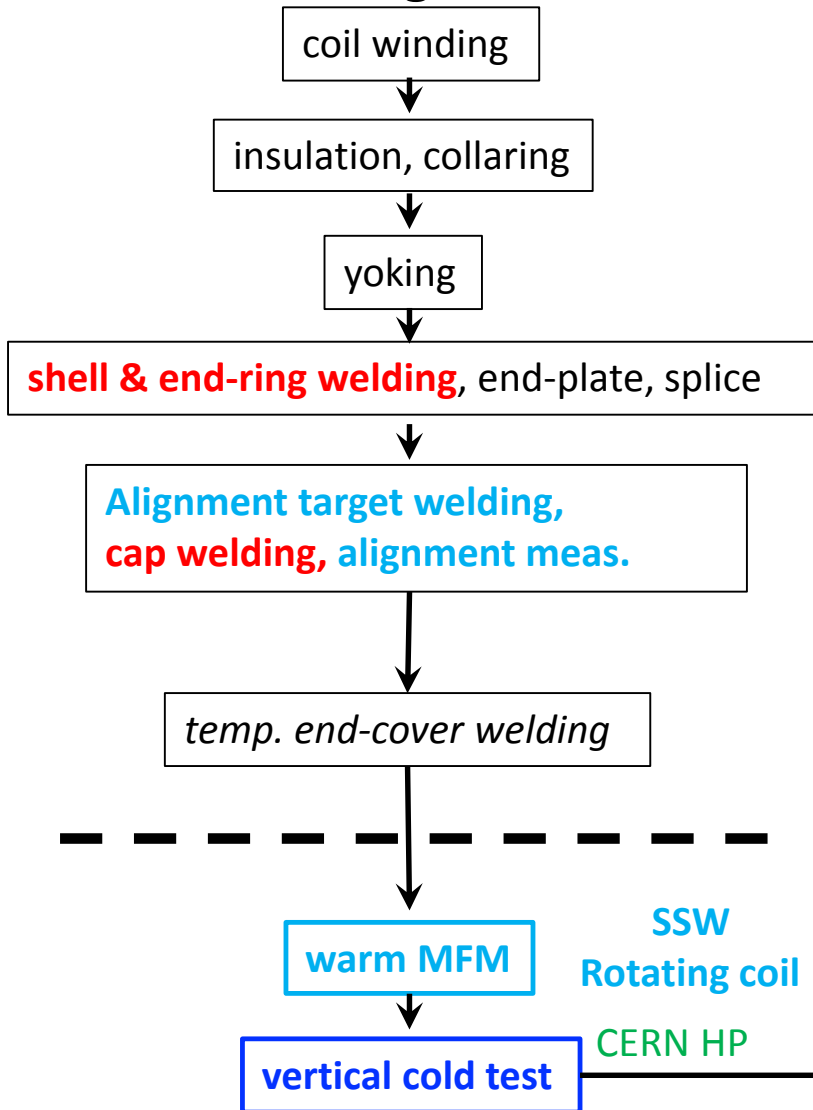


- Two halves shell (t10, SUS304L)
- Structural design of the main body: KEK
- Design of interface (extremities, end-cover, support): CERN (H. Prin)
- Alignment feature on the shell: 8 x 4 holes for targets (like MQXA)

Flow of D1 cold mass production (draft20181001)

manufacturer

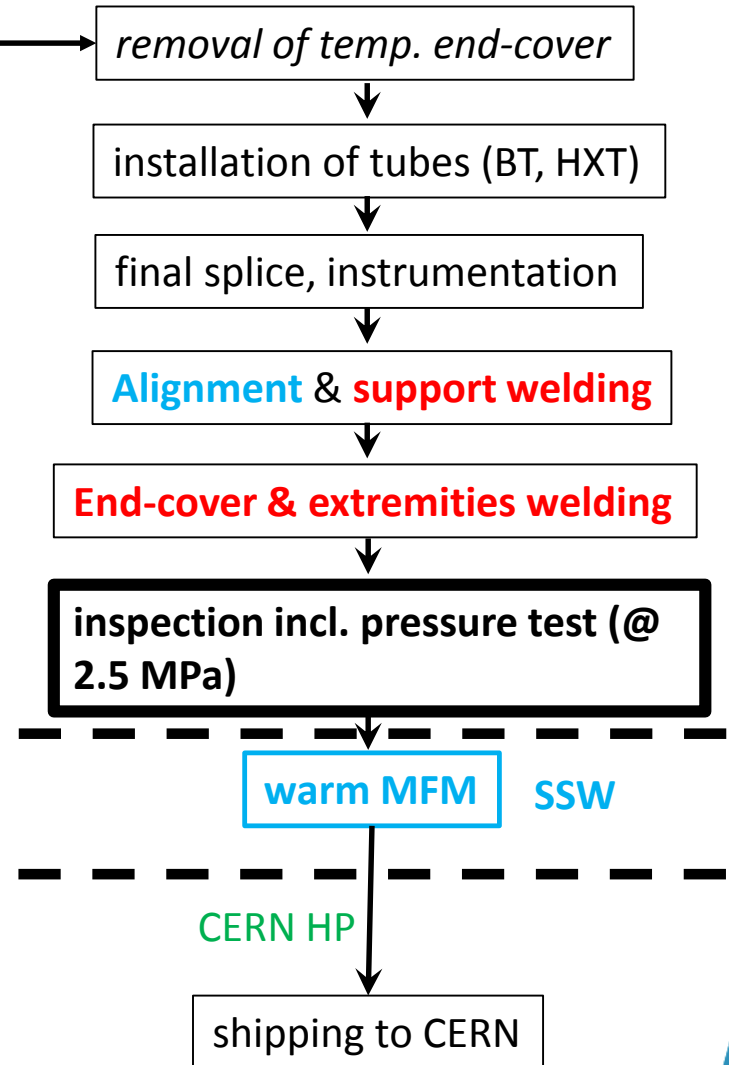
Magnet



Cold mass

manufacturer

KEK



KEK

SSW
Rotating coil

CERN HP

CERN HP

SSW

Planning of delivery DEADLINE for the supplies from CERN

Version 20181016

Year/Month/Day

Magnet ID	Proto 1	#1	#2	#3	#4	#5	#6
Deadline	19/5/1	20/2/13	20/5/13	20/7/14	20/9/9	20/11/11	21/1/8
SC cable (1unit: 660m)	p1, r2, s2	p1, r2, s4	r2	r2	r2	r2	r2*
QPH (Type A & B per coil)	r2, s2	r2, s4	r2	r2	r2	r2	r2*
Deadline	20/2/13	20/11/4	21/1/29	21/4/28	21/9/1	21/11/31	22/2/25
Beam Tube	r1, s1	r1, s2	r1	r1	r1	r1	r1*
HX Tube	r2, s2	r2, s4	r2	r2	r2	r2	r2*
End-cover	r2, s2	r2, s2	r2	r2	r2	r2	r2*

p: practice, r: real use, s: spare

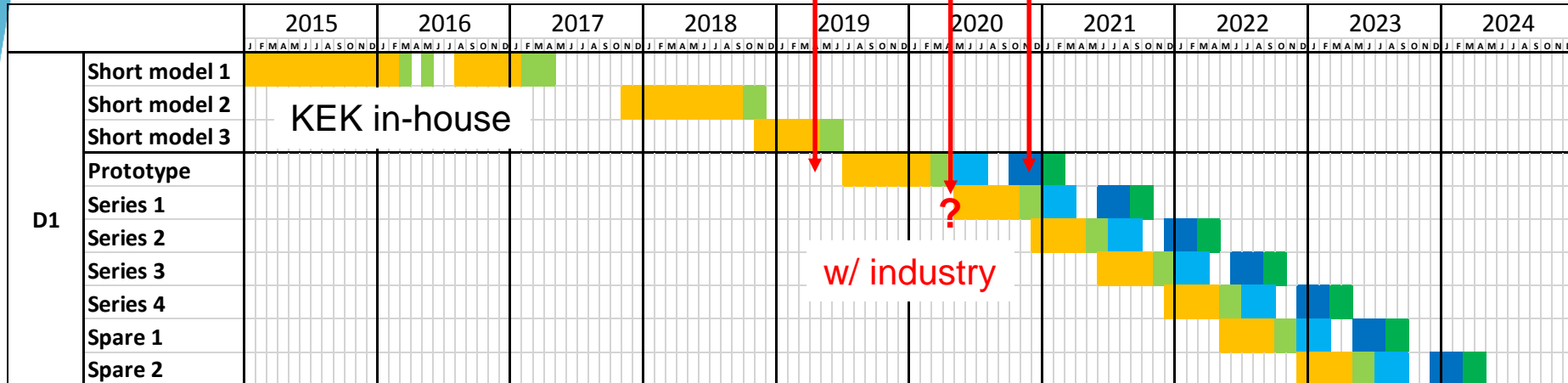
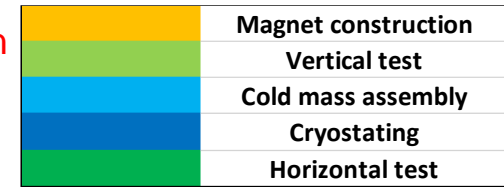
- Based on the Case 1 scenario where the production speed is fastest.
- **Production of raw materials (laminates of Cu+SUS+PI) for QPH by CERN** should be earlier than the dates above.
- For SC cable and QPH: 2 months before the coil winding.
- For CT and HXT: 2 months before the cold mass fabrication.
- All items should be delivered together with necessary documents (inspection certificate, certificate analysis, etc.)
- For the #6 magnet, the supply would not be necessary because unused spare be available.

Schedule

Start of series production

Contract signed

Deadline of delivery



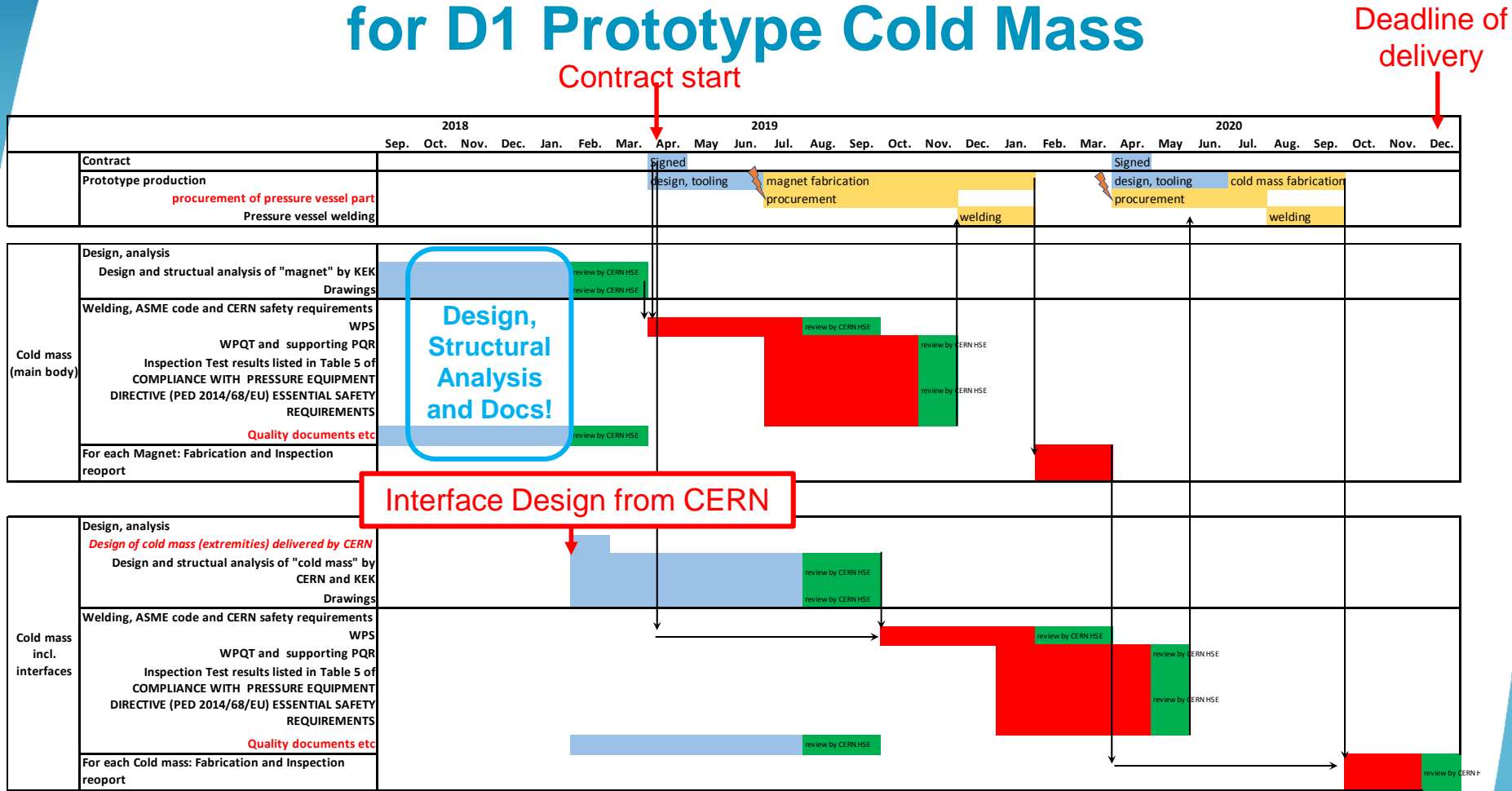
- Model magnet development until 2019.
- A contract of a full-scale 7-m long prototype magnet (MBXFP) will be given at April 2019.
- Production of series magnets (MBXF1-6) will start after the vertical test of the prototype.
- Foreseen milestones: delivery date of cold masses (present baseline)
 - MBXFP (for string test): Sep. 2020.
 - MBXF1-4 (for the HL-LHC machine): Dec. 2022.
 - MBXF1-6 (all): Dec. 2023.

Compliance with PED

Essential Safety Requirements

- Design, manufacture, inspection and acceptance testing of D1 cold mass pressure vessels: ASME Boiler & Pressure Vessel Code2 Section VIII as a baseline
 - Similar approach with LMQXFA of US-AUP
- Discussion recently started with 3 parties: KEK, HL-LHC project, CERN-HSE (notified body)
- Agreement specifying role and responsibility of each party should be prepared very soon.
- Technical Requirements will be defined as well.
- **But, very short time frame is only allowed for preparing the necessary design reports and documents to start the production of the prototype...**

Production Timeline and Approval Processes for D1 Prototype Cold Mass



- Staged approval process necessary for “main body” & “interfaces”
- Only short time allowed for design report, documents: we must be quick!!
- Interface design from CERN (by Feb. 2019) is very crucial (critical).

Need to appoint a CERN expert for the pressure safety issues of the D1 cold mass.

Specification Requirements (TBD)

We have to fix the specification as soon as possible;

- External dimension
- Field angle, straightness, alignment
- Interface: splice, extremities, support, etc
- Fiducials (?)
- Instrumentation
 - In particular for prototype: V-taps, SGs
 - Wire spec.
- Items of performance evaluation test
 - Training quench: criteria defined.
 - But, dedicated tests like “hold at nominal”, “MIITs in QPH induced quench”,...
 - MFM: to be fixed

Specification for open tender must be completed by early January 2019.