

Manufacturing of the first Full Size Model of a SIS100 Dipole Magnet

(Günther Sikler)



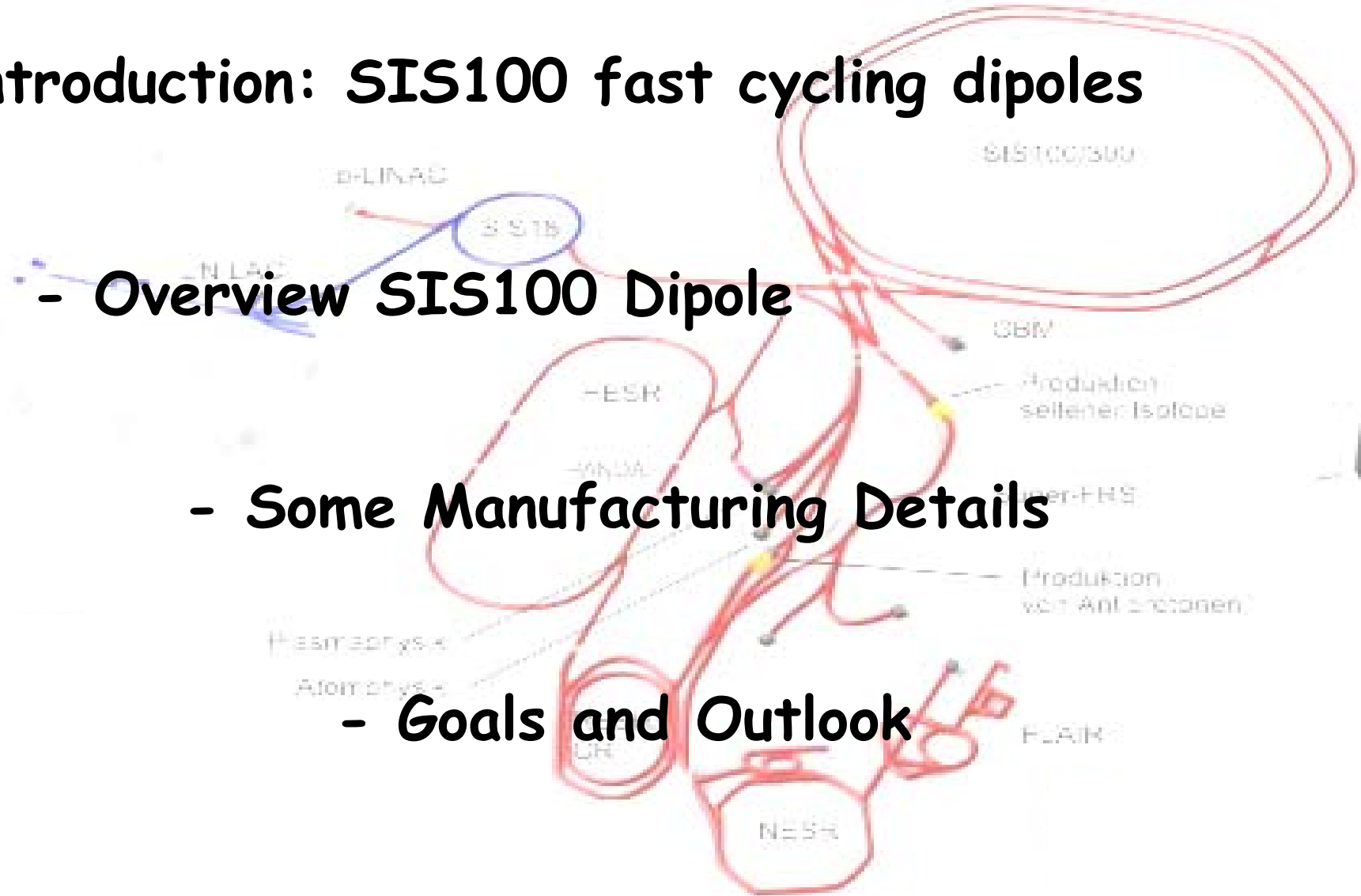
Contents:

- Introduction: SIS100 fast cycling dipoles

- Overview SIS100 Dipole

- Some Manufacturing Details

- Goals and Outlook



Introduction:

SIS 100 - a fast cycling synchrotron

Dipoles:

$B_{\max} \approx 2 \text{ T}$

superconducting, iron-(yoke) dominated

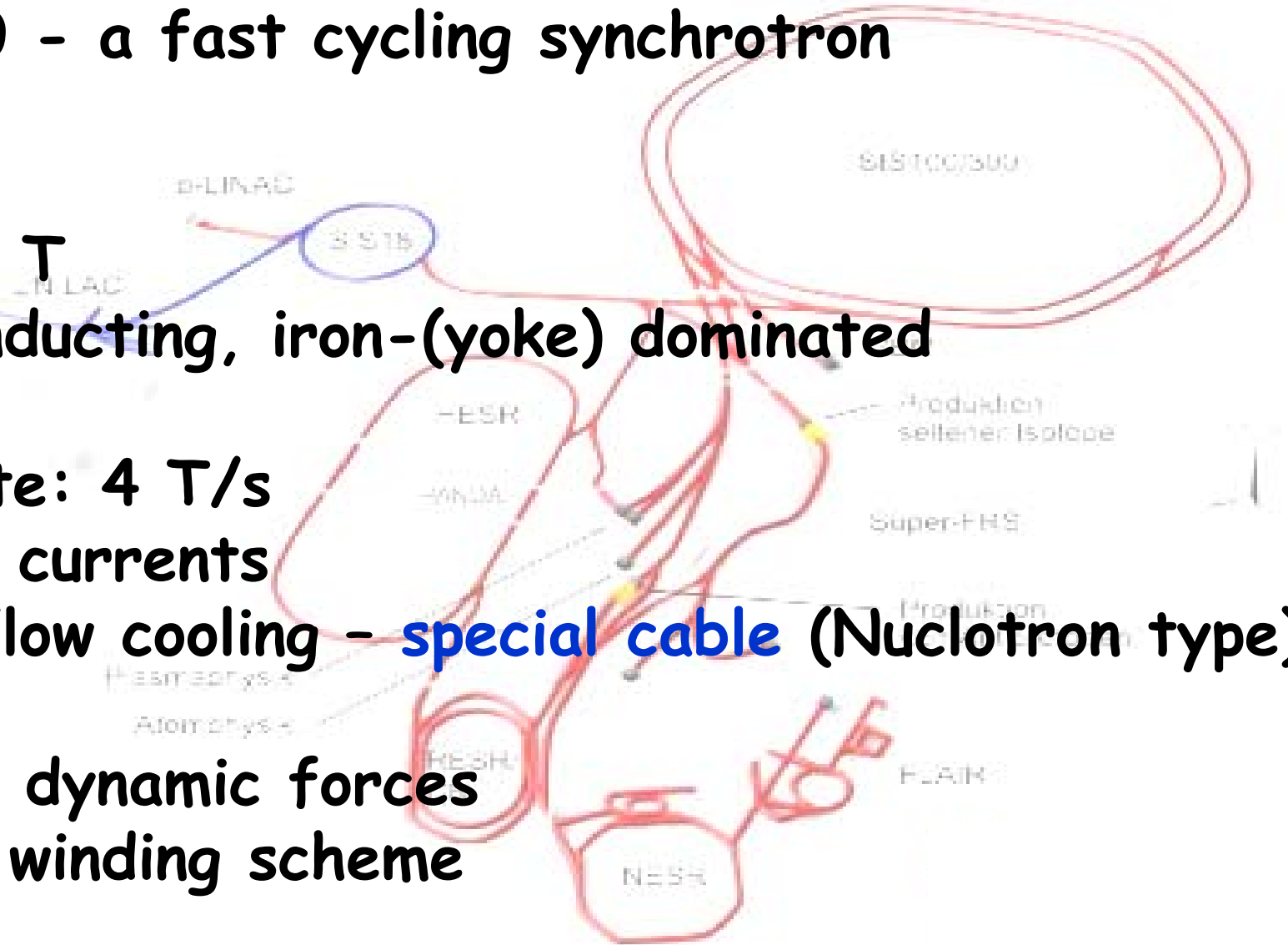
ramp rate: 4 T/s

-> eddy currents

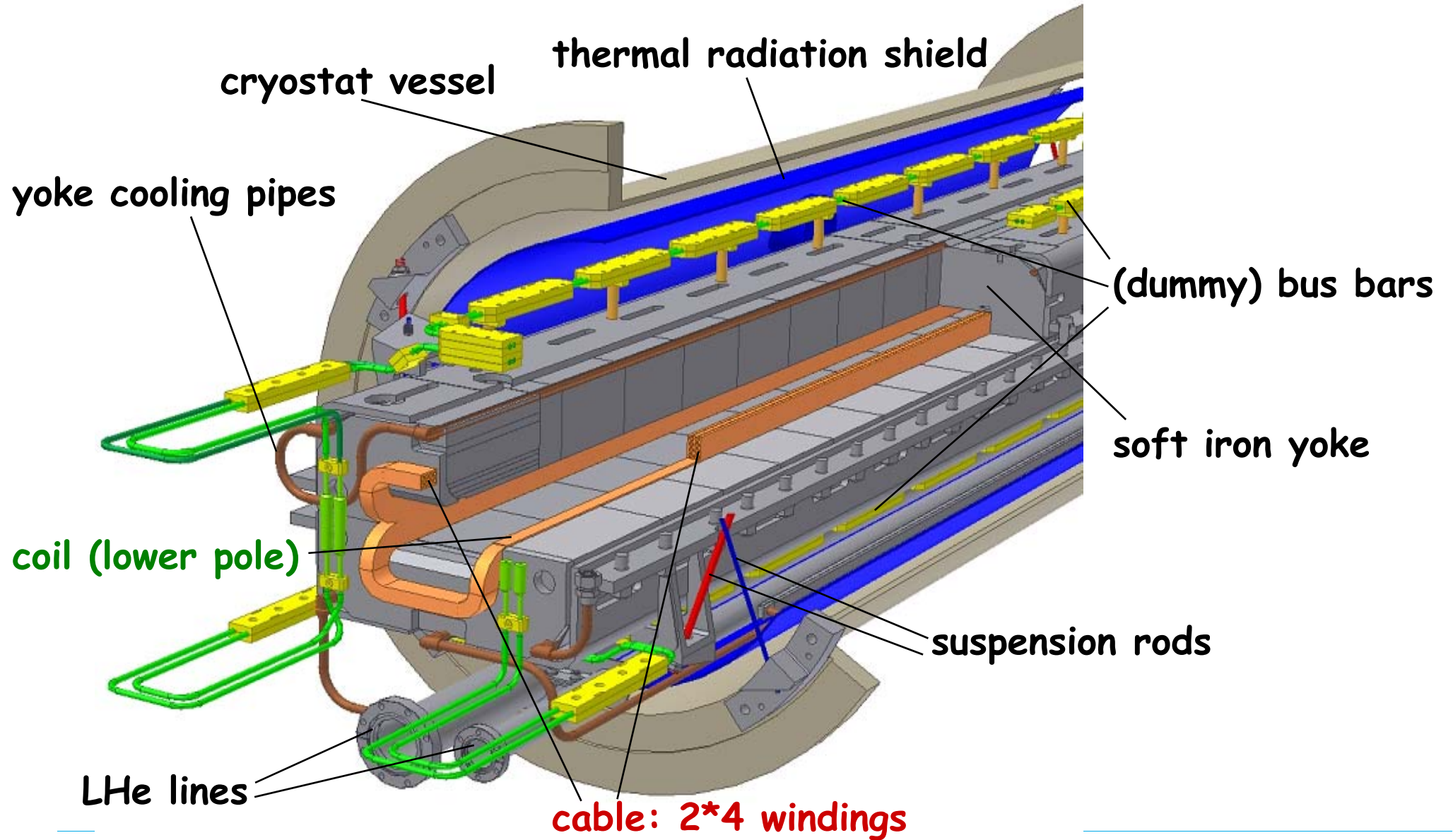
forced flow cooling - special cable (Nuclotron type)

-> large dynamic forces

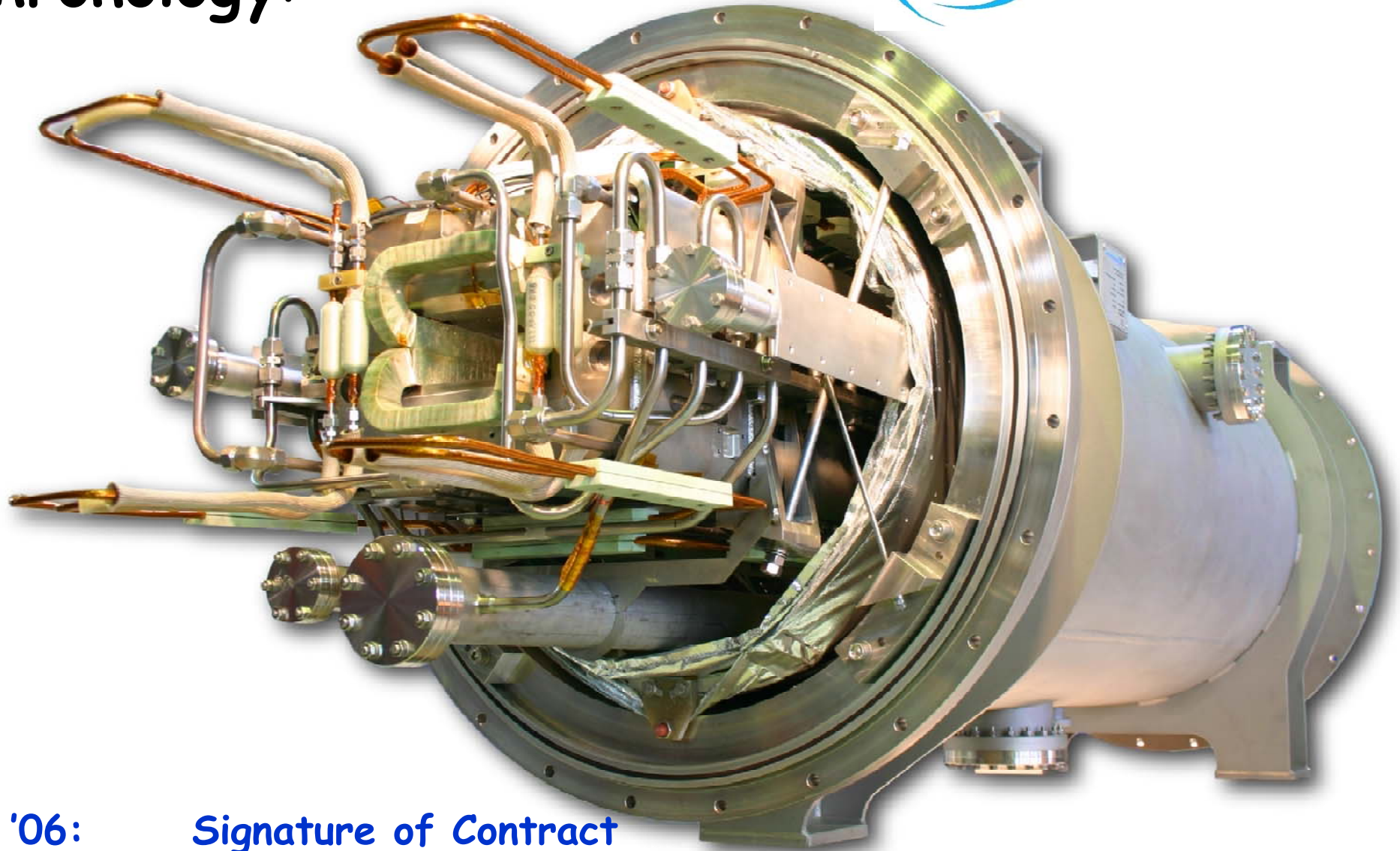
new coil winding scheme



Overview:

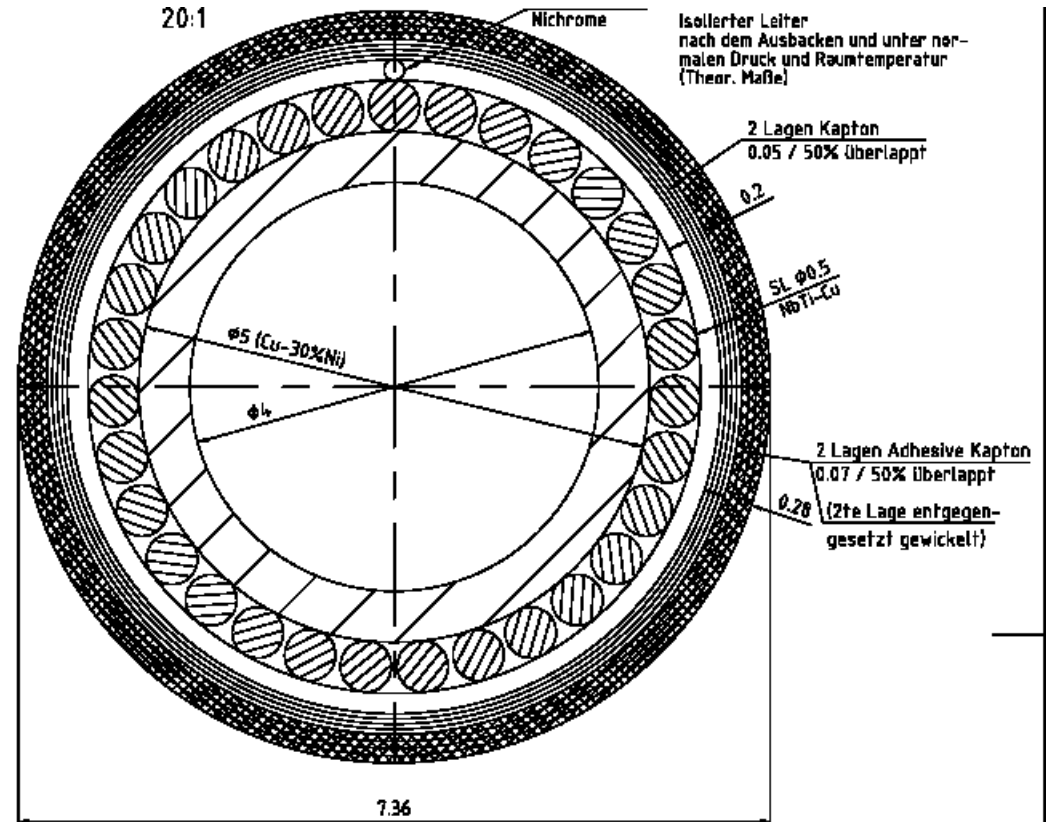
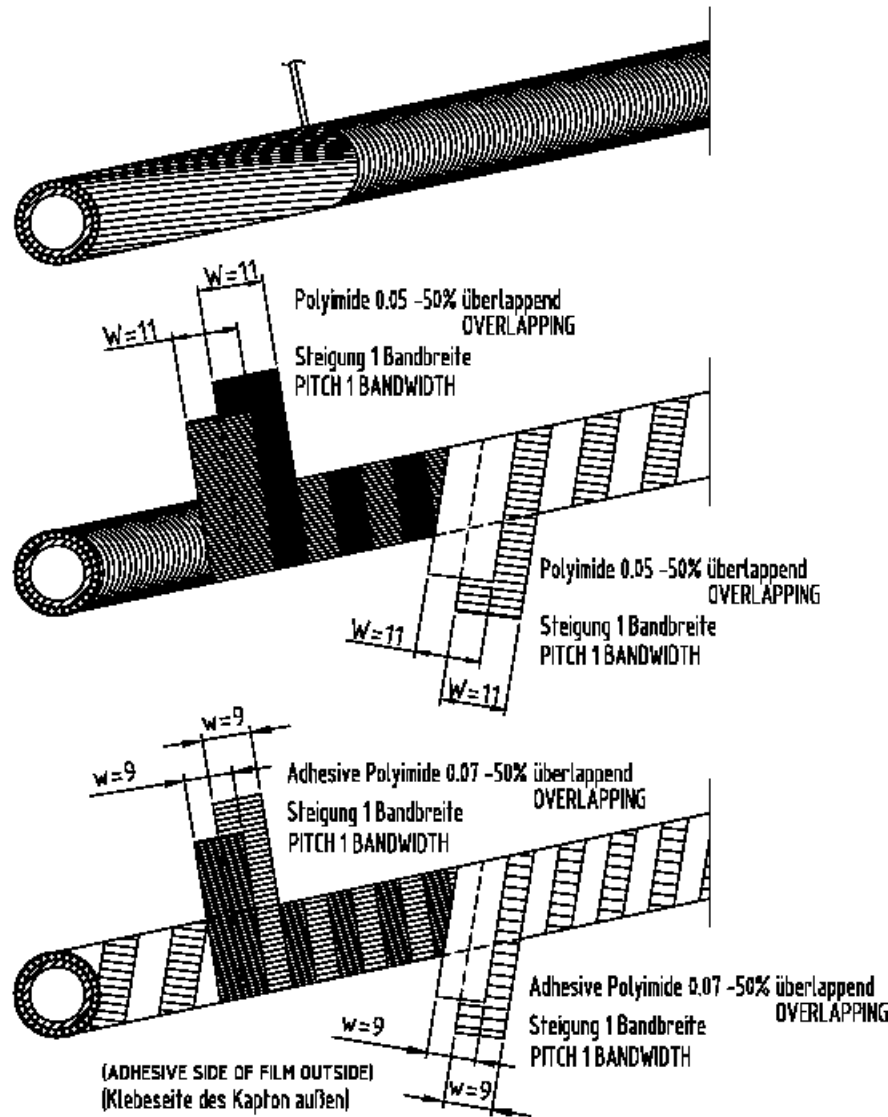


Chronology:



Dec. '06: **Signature of Contract**
April '07: **Final Design Review**

Cable: Nuclotron type



Cooling tube: CuNi, ID = 4 mm
31 superconductor strands
CrNi wire (ϕ 0.2 mm)
4 polyimide tapes

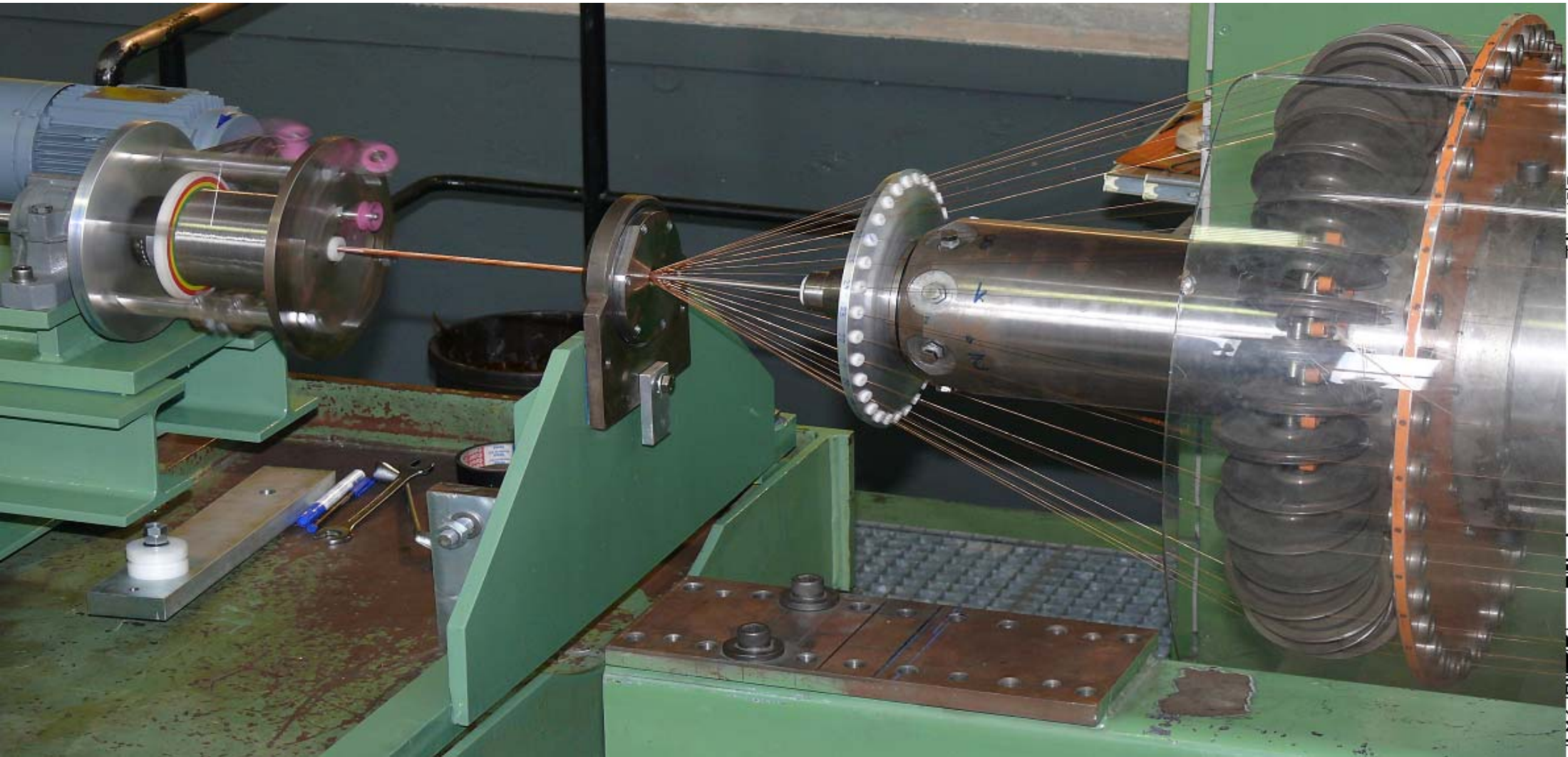
Cabling Machine:

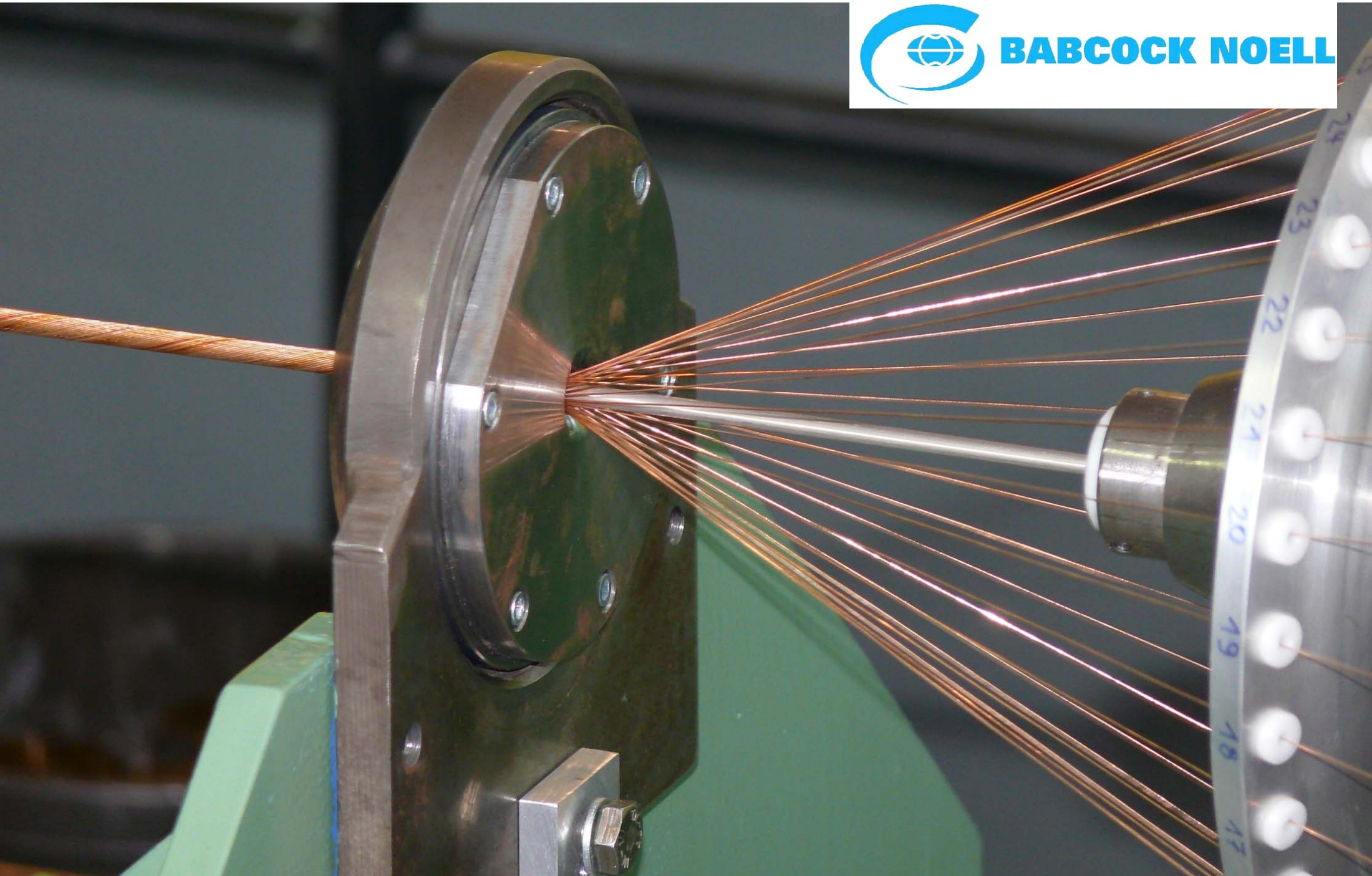


Wrapping Device
for the CrNi wire

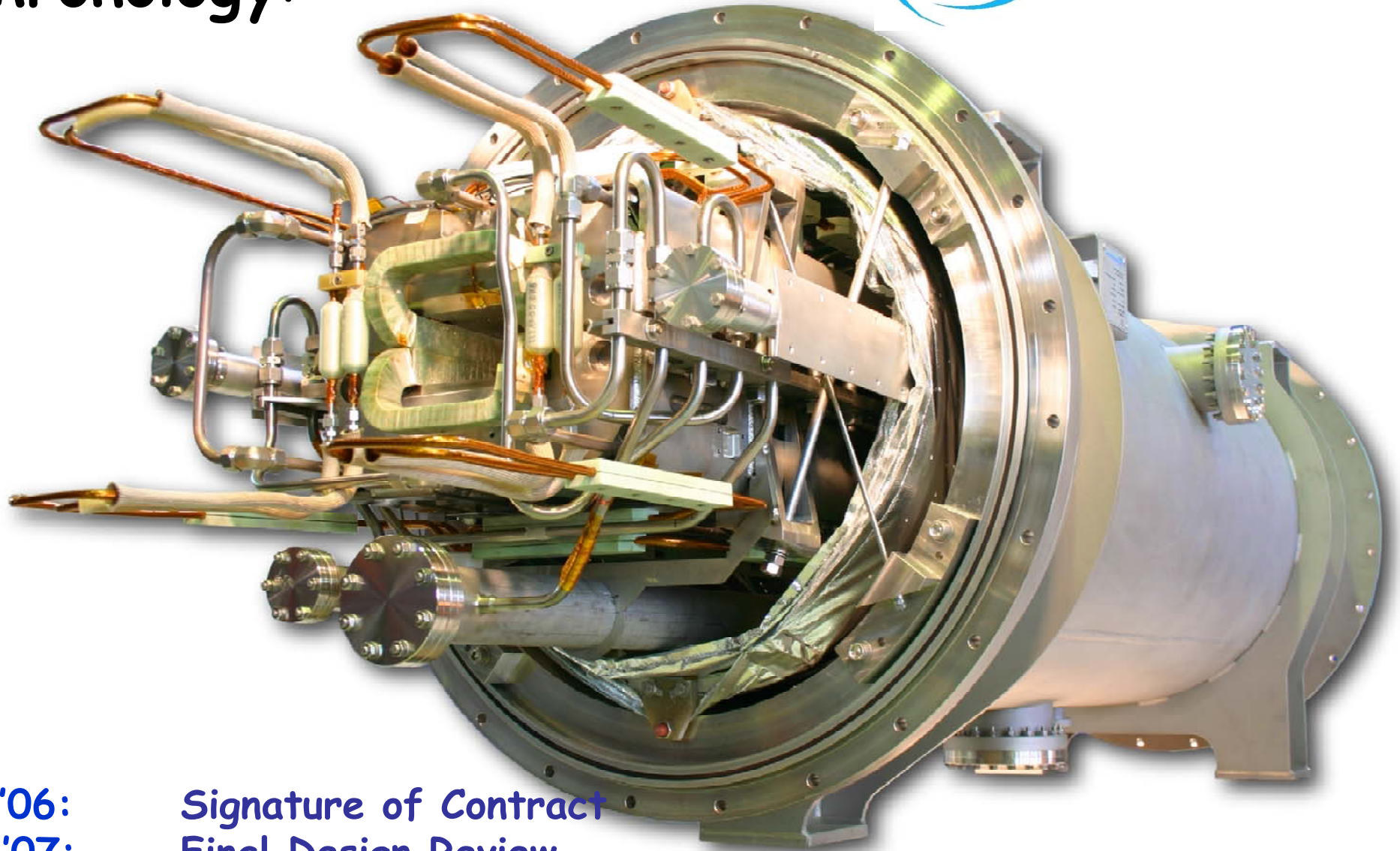
Taping (Kapton)
Devices

Cabling Machine:





Chronology:



- Dec. '06:** Signature of Contract
- April '07:** Final Design Review
- Aug. '07:** Cable Production complete

New Coil-Scheme:

Goal:

- Protect sc cable and the winding pack against movement due to strong dynamical forces
- and position it with high accuracy and reproducibility.

EU-FP6 development program:

- Calculations, Design and Layout
- Winding Scheme*) and Tooling Concept
- Several Test Pieces produced
- Measurement Mech. and Thermal Properties

* IEEE Transactions On Applied Superconductivity, Vol 17. No2 June 2007, pp 1169- 1172
(Proceedings of ASC 06, Seattle, USA, Sep. 2006)

New Coil-Scheme:

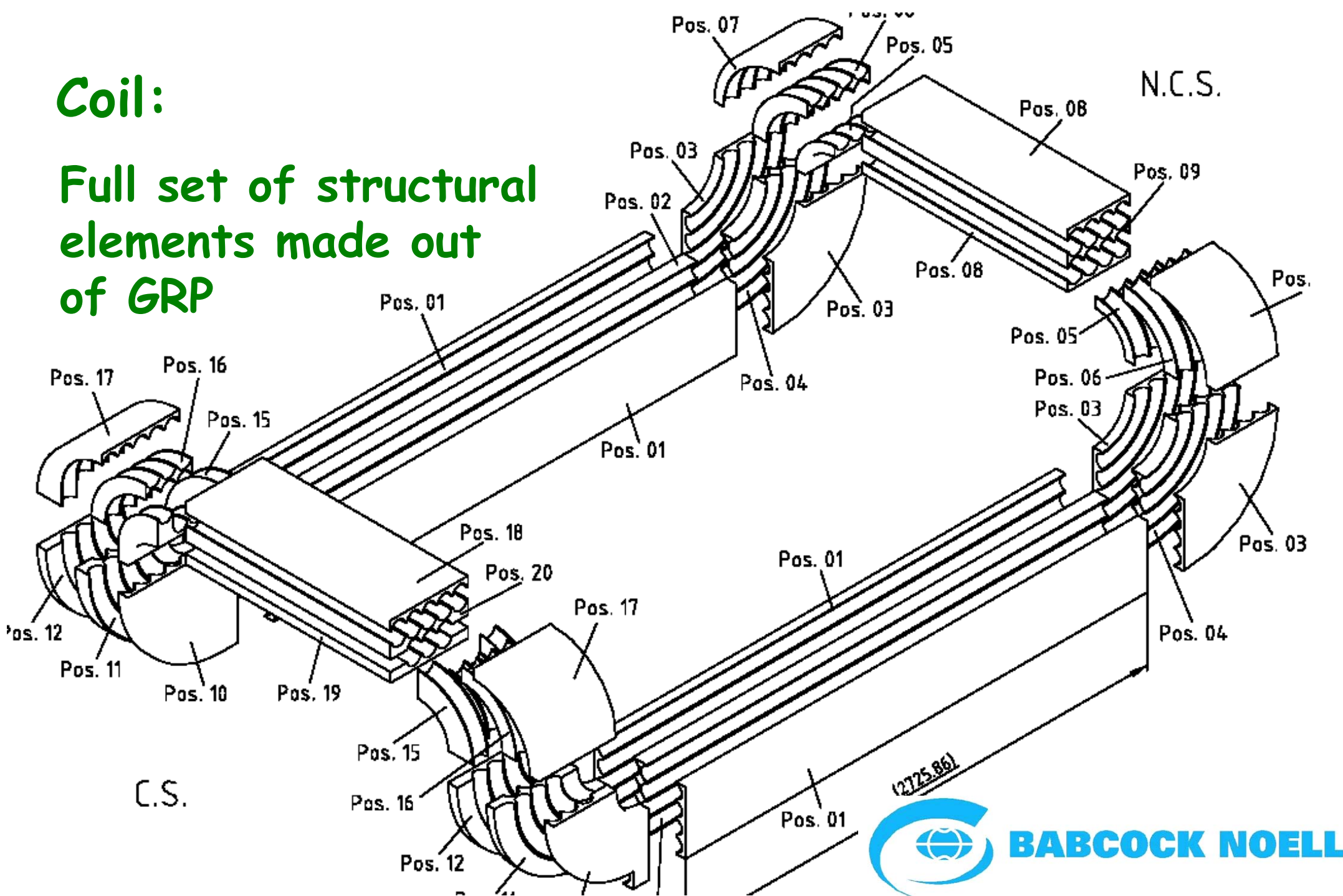
Result:

The cable will be supported and kept in position by specially shaped structural elements, which are made from glass fiber reinforced plastic (GFP).



Coil:

Full set of structural elements made out of GRP



New Coil-Scheme:

Result:

The cable will be supported and kept in position by specially shaped structural elements, which are made from glass fiber reinforced plastic (GFP).

In a combined pressure-heat treatment the winding packs are baked to form a compact, solid structure of accurate dimensions.

The coil is tightly fitting within the yoke (after cool-down). Laterally fixed and axially free to slide.

New Coil-Scheme: The Compact Coil



New Coil-Scheme: The Compact Coil

Activities after FP6 (i.e. this contract):

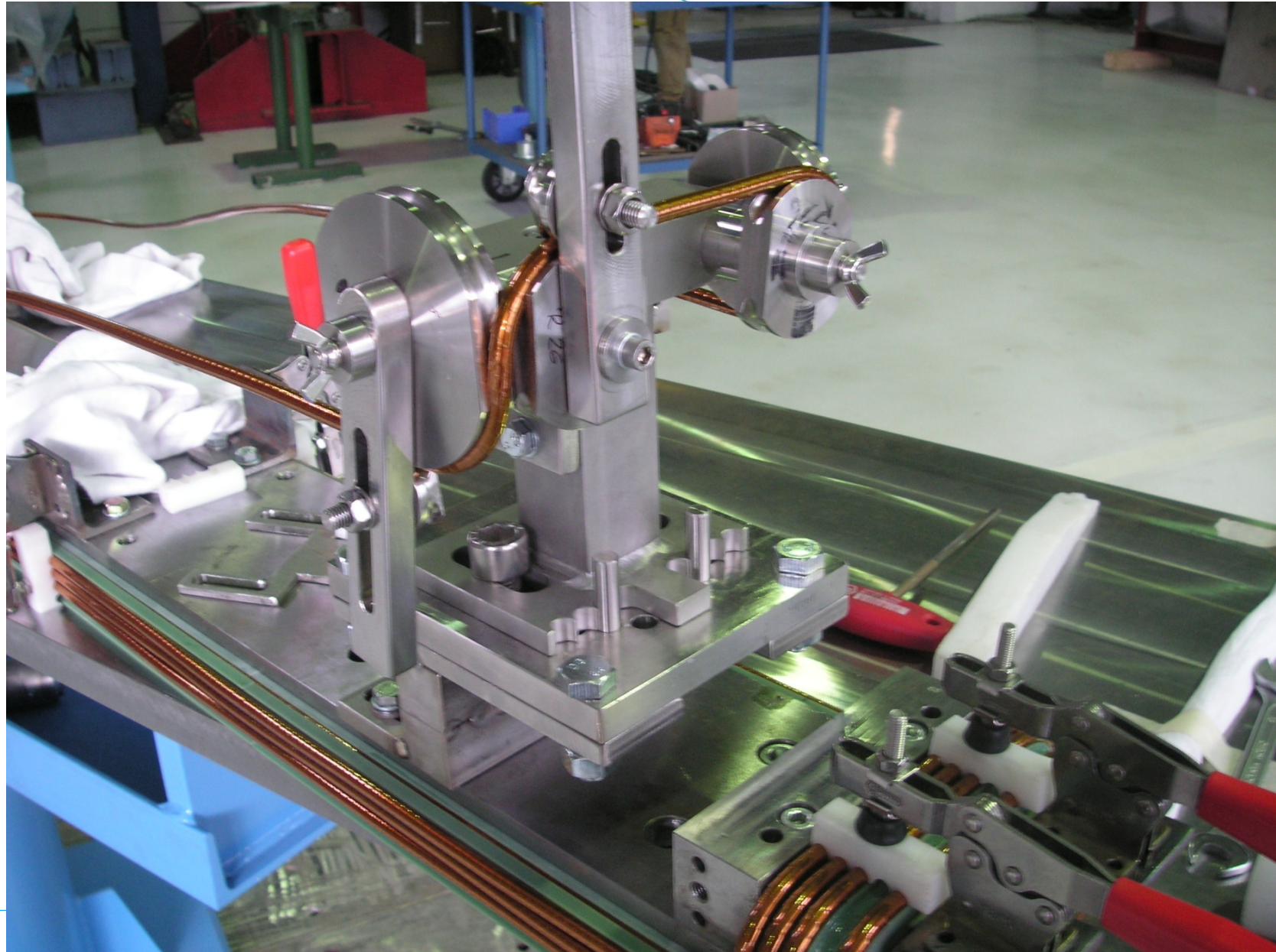
- Development and setup of tooling for full size coils

- Production of first (full length) model coil to qualify and improve winding and backing technology

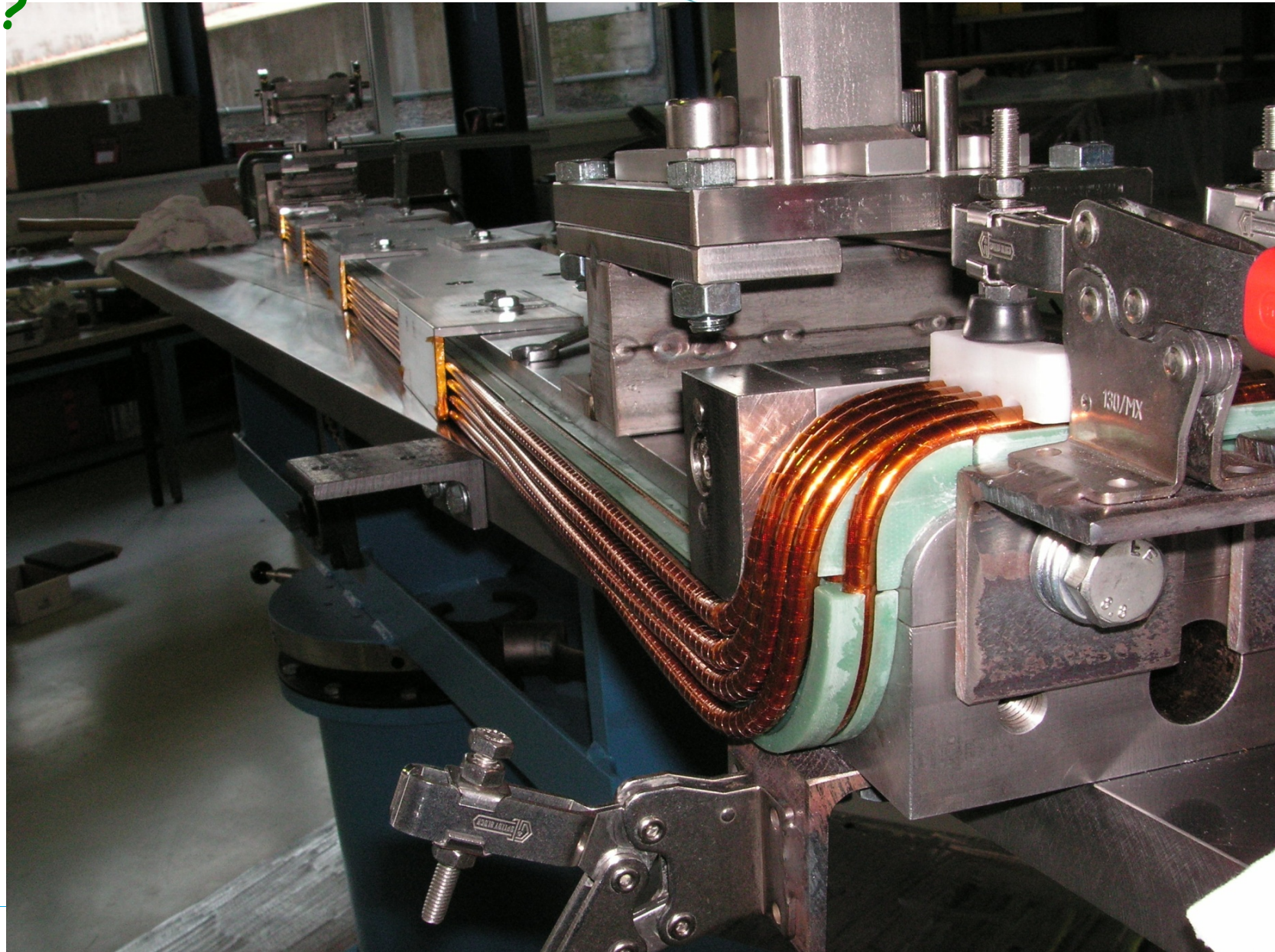
Test coil is prepared at GSI for cool-down, mechanical and electrical test.

- Production of the final coils

(pre-)Bending of Head Sections



Reproducibility and Accuracy ?



Baking under Pressure



Baking under Pressure

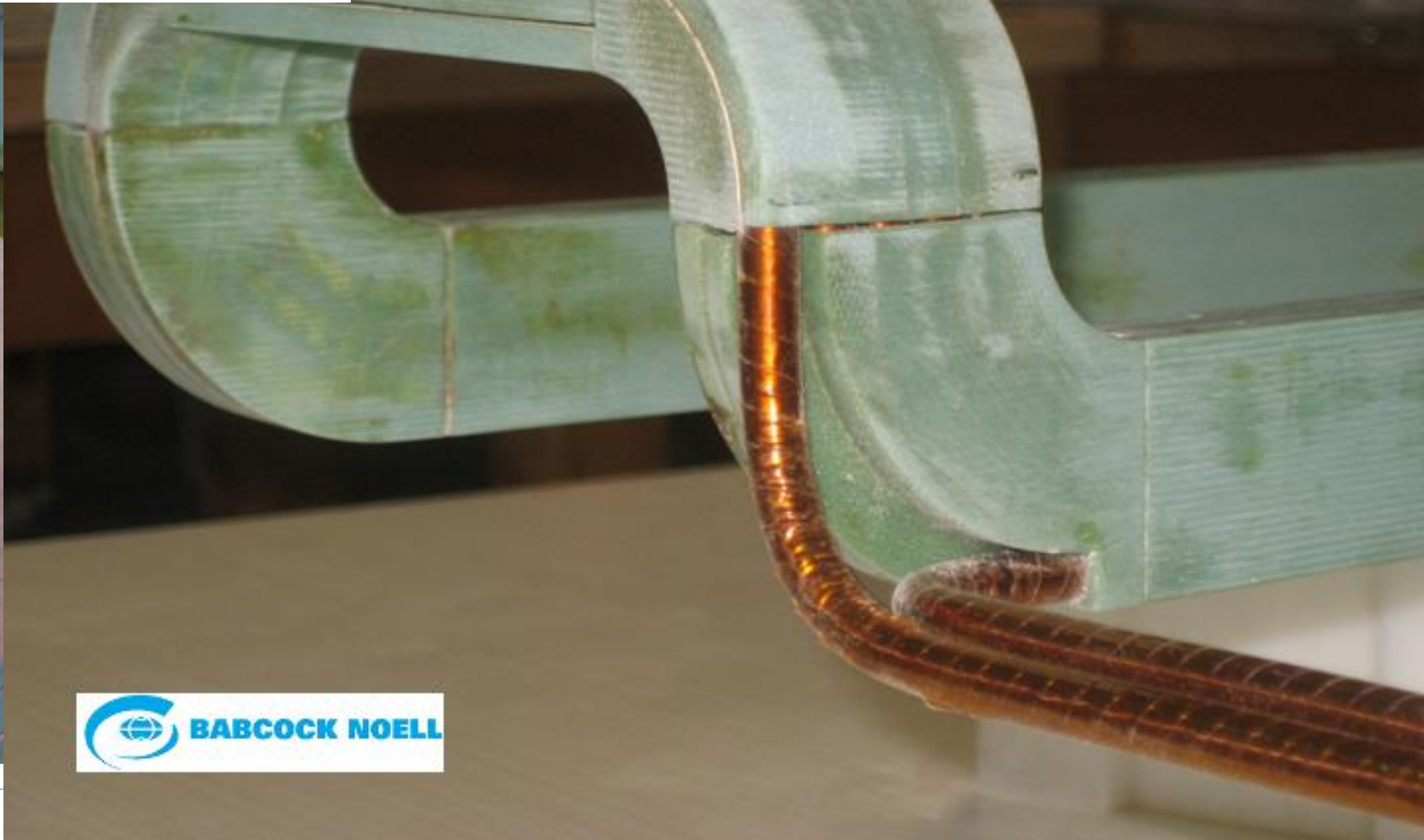
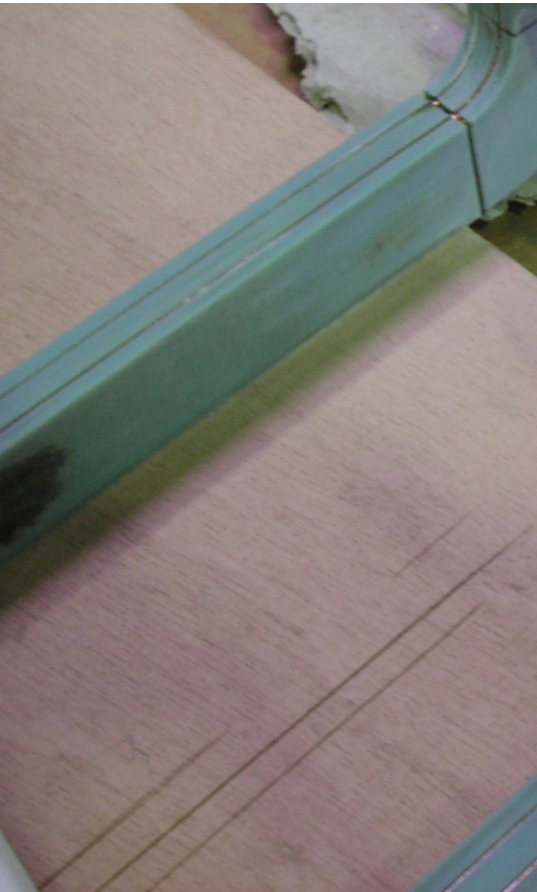


Precision of < 0.05 mm
for Cable Position
and Coil Shape
+ enhancement of
winding pack rigidity



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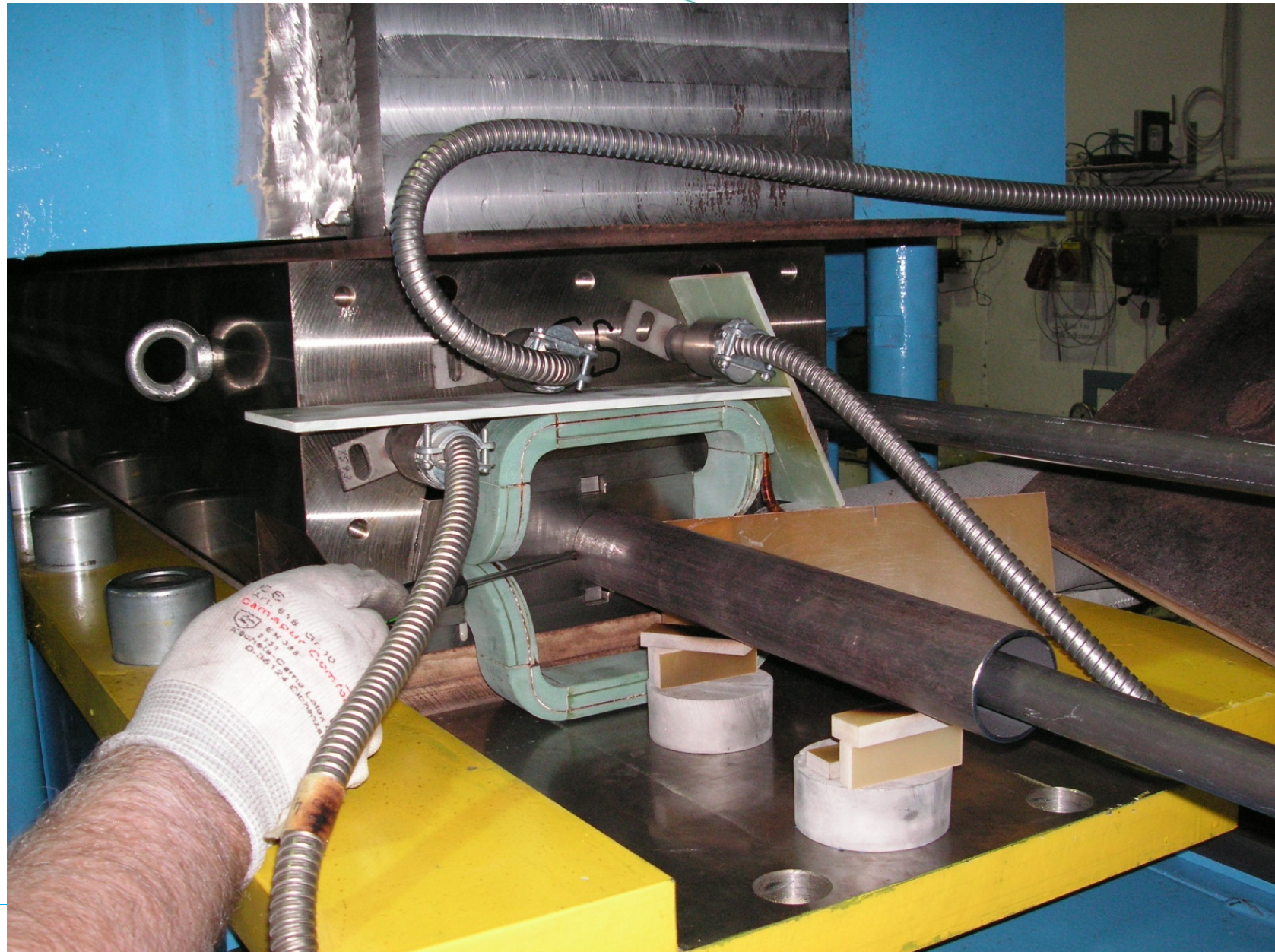
Kopfbereich der ersten
SIS100-Dipol-Halbspule



Taping of the two Poles



And Again:
Baking
under
Pressure:
accurate
shape &
mechanical
stiffness



Chronology:

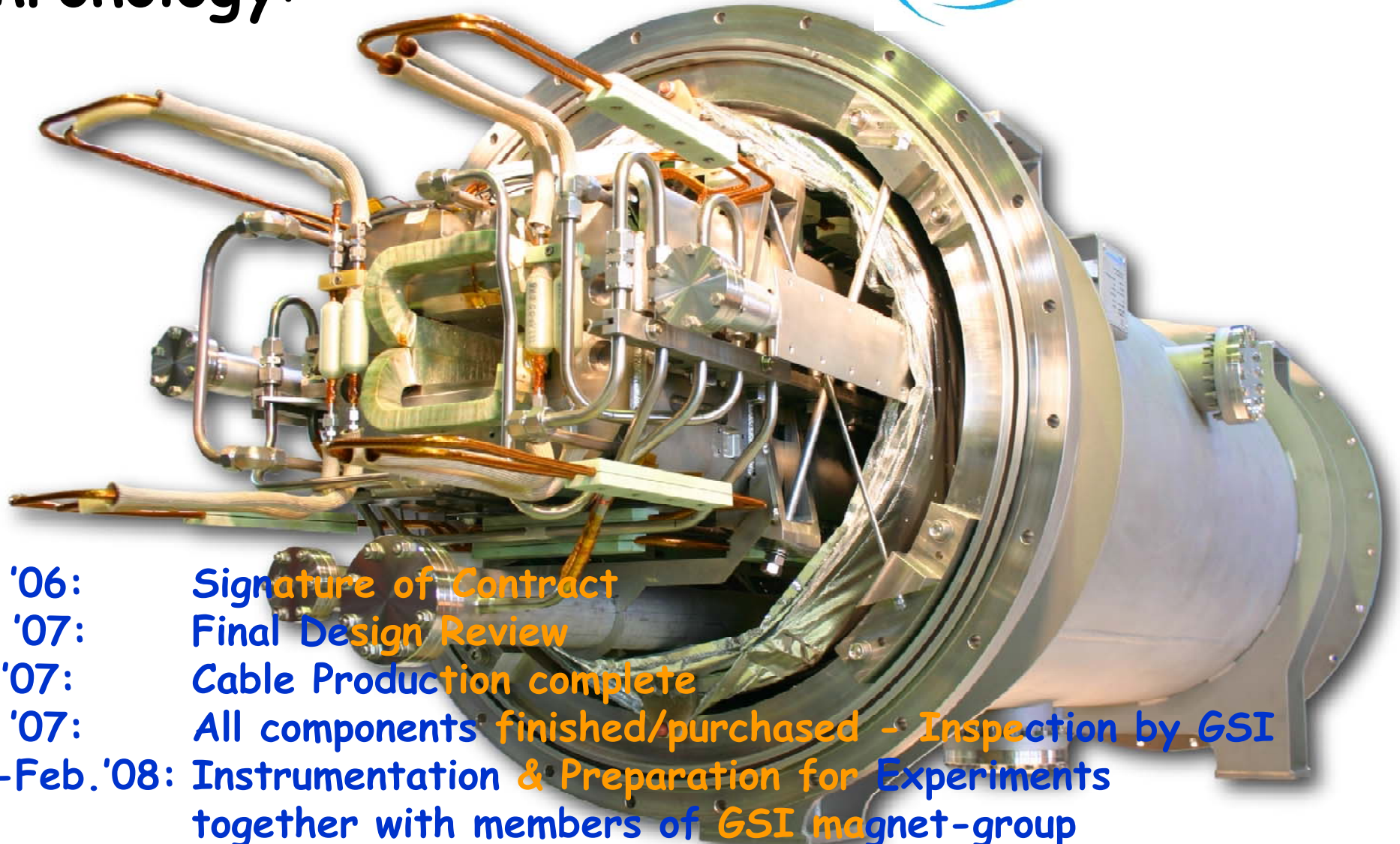


- Dec. '06: Signature of **Contract**
- April '07: Final Design Review
- July '07: Cable Production complete
- Dec. '07: All components finished/purchased - Inspection by GSI





Chronology:



- Dec. '06: **Signature of Contract**
- April '07: **Final Design Review**
- July '07: **Cable Production complete**
- Dec. '07: **All components finished/purchased - Inspection by GSI**
- Jan.-Feb.'08: **Instrumentation & Preparation for Experiments together with members of GSI magnet-group**
- March '08: **Transport to GSI**
- June '08: **First Cool-Down and Test Measurements**

Outlook:

- **Series Production of 108 SIS100-Dipoles**
- **BNG as Collaboration Partner**

Project Management

Design and Layout

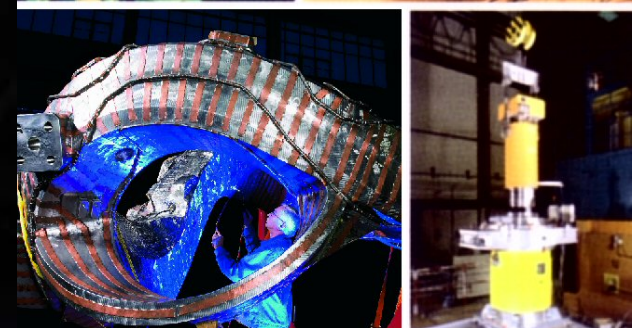
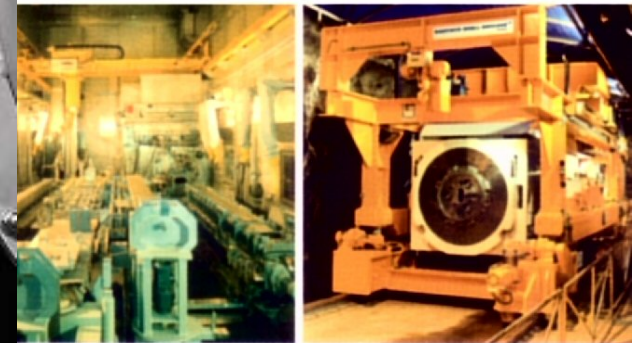
Procurement of (special) components

Manufacturing



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Thank you for
your attention.

From Vision
to Realization.