



Date : 2015-10-07

MEETING MINUTES – RELEASED (V1.0)**Subject: 16T Magnet Technology meeting #02**

Date and Time: 2015-10-07, from 9:00 to 11:00 (~ 2.0 h)

Place: 30-6-041

Participants: Present = , Excused =

Bernhard **Auchmann**, Hugo **Bajas**, Marta **Bajko**,
 Amalia **Ballarino**, Michael **Benedikt**, Luca
Bottura, Shlomo **Caspi**, Gijs **De Rijk**, Paolo **Ferracin**,
 Susana **Izquierdo Bermudez**, Friedrich **Lackner**, Rafal
Ortwein, Juan Carlos **Perez**, Marco Prioli, Etienne
Ro chopault, Daniel **Schoerling** (Secretary), Ezio **Todesco**,
 Davide **Tommasini** (Chair), Arjan **Verweij**, Jeroen Van
Nugteren, Felix Josef **Wolf**, Frank **Zimmernann**

WBS: 1.6.1

File Location/Link: <https://edms.cern.ch/document/1552193>Indico link: <https://indico.cern.ch/event/446669>

Link to previous minutes:

Agenda

1. Introduction	1
2. Report from EuroCirCol: current status and magnet parameters	2
3. Preliminary concepts of ERMC and RMM	2
4. Discussion on conductor procurement for the ERMC	4
5. AOB	4

1. Introduction

D. Tommasini opened the 2nd 16T Magnet Technology Meeting (002) at 09:00. This meeting aimed in defining the parameters and required lengths of strand for the ERMC and RMM models.

2. Report from EuroCirCol: current status and magnet parameters

D. Schoerling reported on the status of the EuroCirCol study WP5. Currently the collaboration works on Task 5.2; Delivery 5.1 (Overview of magnet design options), deadline: March 31st, 2016. The work is distributed as follows:

- CEA: block design
- CERN: review of the state-of-the-art
- CIEMAT: common-coil design
- INFN: cos-theta design
- CERN, UT, UNIGE: Conductor studies
- TUT: Protection studies

M. Benedikt pointed out that the CCT concept should be included and not be forgotten. **D. Tommasini** proposed to wait for **S. Caspi** to finish his scaling of the existing LBNL design to a magnet fitting the FCC requirements. Additionally, at a later stage, one of the US labs (for example LBNL) could be integrated in the EuroCirCol study, as already in the original proposal a link to the US labs was foreseen.

First preliminary magnet parameters are set (16 T, 4.5 K, 50 mm aperture, 10% margin). **G. De Rijk** pointed out that the temperature is not set and has to remain an open point of discussion. **D. Schoerling** stated that 10% margin at 4.5 K are roughly equivalent to ~18% margin at 1.9K. At this stage the magnet design is independent of this choice. **E. Todesco** remarked that this should be more promoted in the community. However, as a baseline for comparison the above presented set of parameters will be used for the design.

It was confirmed, that for the moment the critical current will be calculated without considering its strain-dependence.

S. Izquierdo Bermudez confirmed that for ERMC and RMM the same structural analysis assumptions are used as the ones presented on Slide 5&6 for EuroCirCol.

The next deadlines of the EuroCirCol activities are:

- End of August: design parameters, constraints and evaluation criteria (done).
- End of October: first electromagnetic design.
- End of December: first mechanical design. Identification of problems for further analysis.
- End of March: overview of magnet design options.
- Within end of April: internal review by an international advisory committee and choice of the option.

3. Preliminary concepts of ERMC and RMM

S. Izquierdo Bermudez presented a preliminary design of the ERMC and RMM concept. The strand diameter has been fixed to 1 mm, with a Cu/Sc ratio of 1/1.

D. Tommasini will take care of testing with a dedicated test set-up the break-through voltage of S2-glass/Mica tape (as used for the 11 T dipole project) before and after HT in the High-Voltage laboratory. This test will explore the ultimate break-through voltage of the S2-glass/Mica tape.

The cable insulation thickness is set to 150 μm , the inter-layer insulation is set to 1.1 mm.

The baseline design has been performed with the following main parameters:

- ERMC: 8 % for a coil peak field of 16 T at 4.2 K
- RMM: 10 % for a bore field of 16 T at 4.2 K

The saturation effects due to the iron pole is $b_3 \approx 100$ units.

At 16 T the average stress is similar to the one of Fresca-2 at 15 T (around 120 MPa).

A preliminary mechanical design has been presented, showing that with a bladder pressure of around 50 MPa and a shell thickness of 70 mm sufficient pre-stress is applied. **J.-C. Perez** confirmed that bladders were tested up to 65 MPa without any problem.

The graded solution is under study by **E. Rochepault**.

Concerning the cable length, it has been decided that the following wire has to be ordered in a first stage:

- wire for two double pancakes + 1 spare with 45 turns (1.5 ERMC)
- wire for one double pancake + 1 spare with 42 turns (middle coils for 2 RMM)
- wire for the above mentioned coils with reduced size

The required total wire length will be communicated by **S. Izquierdo Bermudez**. The wire diameter of 1 mm, Cu/Sc ratio 1:1 is confirmed. On this aspect **S. Izquierdo Bermudez** presented a study showing the impact of Cu/Sc ratio and of the wire diameter on the magnet design

Once the final wire length is defined, **A. Ballarino** will propose a strategy for the purchase.

L. Bottura suggested to perform a study of the suitability of the magnet structure for different coil configurations, with the following options ERMC, RMM with 10% margin, 16 T AND RMM with 5% margin, 16 T - a coil which would reach 16 T at 10% margin, if build with FCC target strand.

The insulation thickness is defined at 0.15 mm, which allows using a glass/mica tape still providing about 7% saving in coil width compared to a 0.2 mm thick insulation.

A baseline design for non-graded coils has also been presented. This may be used as the basis for a staged program featuring different coils, non-graded and graded, with different wires, entering into the same structure.

Start of winding of the first ERMC coil is foreseen in autumn. The next steps is the electro-magnetic design of the graded magnet. In parallel, a detailed mechanical design including assembly features and longitudinal loading will be performed for all discussed options, as suggested by **L. Bottura**.

L. Bottura suggested to start trial windings of the ERMC, compatibly with the other activities in 927, with existing wires as soon as the tooling is available.

J.-C. Perez will explore the full-time availability of a skilled draftsman to start by mid-November.

4. Discussion on conductor procurement for the ERM

This presentation was postponed to the next meeting.

5. AOB

Next meeting will be a FCC magnet technology meeting. The following topics will be discussed during the next upcoming meetings:

- Design of quadrupole magnets
- Mechanical solution of dipole-like collars for quadrupole OR IR-quadrupoles for the ee-collider

Next 16T dipole magnet meeting (November 18th):

- Technical challenges of Fresca-2 magnet
- Status of procurement of wire