Draft report of the CBM Dipole Conceptual Design Review at Darmstadt May 22-24 2017

Findings

The committee appreciates the quality of the presentations given during the meeting. However, the committee noted that the conceptual study is still at an early stage. It has been agreed after discussion that the conceptual design study must continue with the aim to be completed by fall of 2017.

The main recommendations are summarized below.

Recommendation 1

We recall that it is essential to reach B*L=1 Tm. In order to reach that we allow to modify the following parameters:

- Cu/SC ratio >6
- Test current: +5%
- Hot spot temperature (without protection system): <200 K
- Quench voltage (without protection system): <1200 V
- Working point < 60% of the load line
- No specification of the type of insulation

Recommendation 2

The conceptual design study shall include a 3D electromagnetic study including field map in the yoke and the description of the magnetic properties of the materials ("B-H-curve") as well as a 3D structural analysis of the coil.

Recommendation 3

A particular feature of this magnet is that the coil has to slide during the energization against the fixed supporting plate. This generates energy release possibly inducing unwanted quenches. Considering that a similar magnet (SAMURAI) is operating successfully with coils immerged in a helium bath we recommend the same principles for the CBM dipole (including highly conductive plates) in order to reduce the technical risk. Therefore we strongly recommend a helium bath cooling.

Recommendation 4

For the coils we recommend two independent cooling circuits in parallel.

Recommendation 5

Reduce the thermal losses in the supports at 4.5K by at least a factor of three, for example by increasing the number of cylinders, reducing the cross section, using other material.

Recommendation 6

Implement two fully independent protection systems including quench detector, breakers and dump resistors.

Each protection system must be able to absorb the complete energy.

The grounding strategy must equilibrate the voltages with respect to ground during fast discharges.

Recommendation 7

After the selection of the conductor and coil parameters and a TOSCA analysis (calculation of the inductances and the max. coil field) make a careful quench analysis with for example the SQUID quench program.

Recommendation 8

Design and test the current leads so that they can support the nominal current for 1 minute without any cooling.

Additional remarks:

- We observed a difference in the integral field (B*L) result compared to the TDR design. The following changes have been made.

1. Gap 1.4m to 1.44m
2. Return yoke shape was changed
3. ARMCO steel was chosen for the conical pole (no B-H curve presented) , 1010 in the TDR
4. COMSOL code instead of TOSCA
5. Unchanged: coil size; N*I= 1.2 MA; I=686 A

It is suggested to repeat the B*L calculation with unchanged parameters 1-3 in order to reproduce the former results. Afterwards check the influence of the parameter changes and optimize the field design.

- A convincing cryogenic distribution system is missing. It must include also the operation of the HADES magnet. According to the specification CBM dipole and HADES magnet must be cooled down or warmed up independently. Define the cryogenic system in close contact with people at GSI.