February 22, 2017

v.3

MDP 16 T dipole: Target parameters and specifications

1. Geometrical

* Magnet total length <2 m
* Magnet straight section >200 mm
* Free coil aperture 50 mm
* Maximum magnet OD (reference number) 610 mm (FNAL/1.9K), 660 mm (BNL/1.9K), ………………………………………………………..914 mm (LBNL/4.5K)

1. Conductor

* Strand diameter 0.7-1.2 mm
* Cu:nonCu ratio 1.0±0.1
* Non Cu Jc(16T,4.2 K) 1300 A/mm2
* Reference Jc(B,T) fit see below
* Ic degradation due to cabling 5%
* Maximum number of strands in cable 42 (FNAL), 60 (LBNL)

1. Operational

* Reference temperature 1.9 K
* Nominal operation field 16 T
* Margin on the load-line @ 1.9K 10 %
* Geometrical field harmonics at Rref=17 mm bn<3 for n<10 (magnet straight section)
* Target design field 17 T
* Maximum coil stress 180 MPa (150 MPa during assembly)
* Maximum coil-pole separation @ 17 T <10 µm for cable width <50%

1. Quench protection

* Maximum hot spot temperature 350 K
* Total time delay 40 ms
* Maximum voltage to ground @ quench 1.0 kV
* Ground insulation design voltage >5 kV

1. Reference Jc(B,T) fit:

, ,

where 𝑡=𝑇/𝑇c0; 𝑏=𝐵p/𝐵c2 (𝑡), *Bp* is the conductor peak field, *Tc0* = 16 K, *Bc20* =29.4 T, *C0*= 270 T.kA/mm2.

1. Each magnet concept should provide

* Description of magnet design including
  + Strand, cable and insulation (before and after reaction)
  + Coil cross-section (number of layers, number of turns, conductor weight/m/aperture)
  + Coil end design
  + Magnet support structure including transverse and axial support
  + Quench protection system
* Maximum magnet bore field Bmax at conductor SSL for 1.9 K and 4.5 K
* Dependence of Bmax on conductor Jc(16T,4.2K)
* Calculated geometrical field harmonics, coil magnetization and iron saturation effects in magnet straight section at Rref=17 mm for B=1-16 T
* Stress distribution in coil and structure at room and operation temperatures and at the nominal (16 T) and design (17 T) fields
* Coil-pole interface (gap) at the nominal (16 T) and design (17 T) fields
* Coil maximum temperature and coil-to-ground voltage during quench