



CDR – Magnet circuits

- FCChh (1 page)
 - Key parameters (L, stored energy, V_GND, P_cons...) and main PROs and CONS leading to the circuit variant retained as the proposed baseline (add a sketch and maybe a simulation with circuit voltages during extraction, location of PCs and EEs,..)? -> Marco/PE (primarily main dipole, no magnet parameters for quads, correctors...) All other circuits follow dipole with reduced EE< cold bypass diodes
 - For CDR MSC has selected CT as baseline (confirm with WP5)
 - If space allows, briefly mention other variants studied (including also other magnet variants). -> Marco/PE
 - Mention eventual deviations as a function of final magnet type and the considered protection mechanisms, CLIQ (baseline), QH, combination. -> Marco/PE
 - LHC magnet diode bypass assembly and propose required diode parameters in connection with the powering architecture of the magnets (reverse voltage during ELQA) -> maintain (as part of circuit drawing), radiation levels -> New development
 - Link to powering requirements/proposal by EPC (DC distribution idea...)-> Marco/Markus
 - Link to CRG for additional sc links + space -> Marco/Markus
 - Challenges and risks (rad hard diodes, system of links + feedboxes, availability..)
- FCCee
 - Primarily between MSC and EPC. Converge for total L/Energy, but no QD, EE,... (but large 'WIC' - tbc) -> -> Marco/Markus -> Attilio Milanese
- HE-LHC
 - Baseline energy (13.5TeV) -> Report of Vivien
 - Refer to FCC studies based on FCC magnet
 - Probably similar LHC, depending on baseline for magnet scenario (check with MSC/project), i.e. all 16T FCC or 10o3... Latter is very tricky as no flexibility to re-design full cold-powering busbars -> Marco/PE
 - Voltages during extraction already at limit, need at least one additional EE in middle of arc and a power converter on either side, which is far from obvious for space, radiation... (unless new small alcove a la RR or sc link into REs) -> Marco/PE
 - DFBs together with sc links?

CDR – Magnet protection and EE

- FCChh
 - Short summary of main requirements for FCC magnet quench detection and constraints from mechanical stress analysis during quench -> Marco/PE
 - Quench detection technologies for FCC, radiation tolerance and installation (high speed data links/optical transmission with rad tolerant sensors), universal QPS, new fieldbus technologies, protection vs diagnostics (neural networks for detection & analysis), novel/active energy extraction systems for FCC and synergies with power converter design -> Tomasz/Vasilios
 - Prepared in a way to identify challenges (stored energy, possible ways to solve it such as energy recovery towards DC grid -> ideas, switching by quenching sc bypass)
 - Study alternative methods for QD (magnetic, acoustic, radio-frequency, didt sensors) -> New R&D in WP12
 - Challenges and risks: Radiation (electronics to central protected places, minimum in tunnel...) -> First architecture, maintenance (use of robotics,..)
 - 'Global protection schemes' with centralized processing
- FCCee
 - RAS – large WIC system, thermos and flow-switches for nc magnets -> Jan/MI
- HE-LHC
 - Depending on circuit layout adaptations of LHC system complemented with FCC protection principles -> Marco/Arjan

CDR – (Beam) protection concepts

- FCChh

- Summary of damage limits as $f(E)$ – Yuancun and setup beam intensity for FCC (5E8) -> Needs for Beam Instrumentation -> Markus based on input of Yuancun
- Maintain concept of beam permit loops? Voting logic for optimisation of availability and easier testability? -> Jan/MI
- First ideas of MP architectures and specific requirements for FCC, novel ideas for MP (halo cleaning with witness bunches, several AGs,...) -> Jan/MI
- Integration of dBLM in machine protection architecture (installed at every aperture bottleneck and directly connected to beam dump) -> Jan/MI
- Link with other MPS architecture (injection protection, beam dump,...) -> Jan/MI
- Loss detection in cold environment
- Do we need interlocking all around circumference (for availability?), e.g. reduce quantity in arc?

- FCCee

- Short(er)/similar summary on energy consideration as for FCChh -> Markus based on input of Yuancun
- MP architecture considerations very similar to FCChh, large WIC replaces QD/PIC -> Jan/MI
- More detailed studies of failure cases of nc magnets (<Timeconstants @ >beta-functions) to be mentioned as area of future work -> Jan/MI
- Beam dump? -> ALARA -> Jan to check with ABT (Brennan/Wolfgang)

- HE-LHC

- Probably already covered by HL-LHC extensions of MPS -> Jan/MI

General discussion

- Should we say something about powering/protection of injector upgrades for FCC (scSPS, LHC @ 3.3TeV with 4x ramp-rate)?
- Contribution for availability of FCC already provided by Andrea & Arto
- Agreed to omit HTS magnet protection (apart from Current Lead option)

Next

- Create 3 shared documents to start compiling contributions, targeting first drafts early next week (20/02)!
- Organize short (coffee) meetings with EPC, CRG, ABT to assure coherency of contributions