HFM

High Field Magnets Programme

Introduction to HFM-TE day

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19th September 2024

Contents

- Aim of the meeting and recap of main actions in 2024
- Recap of the structure of HFM
- Summary of activities in the collaborations

Aim of this meeting

- Have a snapshot of the present status of CERN activities and plans
- Sharing with all the colleagues all technical points and collecting feedback and suggestions
  - Budget not to be discussed here
  - Decisions not to be taken here
- Management asked to fit the event within one day
  - We had to skip some WPs, that will be discussed separately
  - There is a total of 19 CERN WPs, we will present 13 of them

Summary of actions

- Steering board March 2024
  - Mandate: setting HFM as a direct R&D
  - Target for Nb_3Sn of 14 T operational field and 90 TeV energy
  - Roadmap for Nb_3Sn FCC-hh option for operation in 2050/55 (and not 2070)
  - Activation of a unique HFM forum https://hfm.web.cern.ch/hfm-forum
- Steering board June 2024
  - Activation of working groups https://hfm.web.cern.ch/hfm-working-groups
  - Order of Nb_3Sn conductor
  - Streamlining of 12 T INFN and CERN activities on Nb_3Sn dipoles: focusing on the same coil geometry

Summary of actions

- Steering board October 2024
  - Cost estimate for Nb_3Sn dipoles
  - Update of deliverable and costs for CERN activities
  - Preparation of ESSP
- First targets for 2025
  - Simplification of structure – considering the activation of PSM
  - More detailed roadmap for proving that HTS can be used for accelerator magnets

Generic and direct R&D

- Generic R&D: producing T, not for a specific machine
  - MDP is a generic R&D from US DOE
  - Mandate: "Explore the limits of technology, …"
- Direct R&D: producing TeV (i.e. T m), for a specific machine
  - LARP was a direct R&D from US-DOE
  - Mandate: "Build a 200 T/m quadrupole with 70 mm aperture for the LHC inner triplet …."
- HFM is a direct R&D, focussed on FCC-hh
  - Mandate from 2024: "Build a 14 T Nb_3Sn double aperture magnet for FCC-hh …"
  - There are also non FCC activities (WP2.6, solenoids for muon collider), but FCC is the main client today

Generic and direct R&D

- MDP - US
  - Generic R&D for high field dipoles for HEP
  - 20 T target, stress management design, reduction of training, operating towards ss
  - Hybrid magnets HTS/Nb_3Sn

- EuroCirCol, followed by HFM programme - CERN
  - Direct R&D for 14 T Nb_3Sn dipoles for FCC-hh
  - Direct R&D for 16-20 T dipoles with HTS (hybrid or not)
  - Focus on sustainability, and cost

- IHEP programme - China
  - Direct R&D for 20 T dipoles for SPPC
  - 4.5 K operational temperature, hybrid Nb_3Sn/HTS, common coil

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About the structure

- We kept the same structure as used in 2022-2023
- Program is structured in WPs (workpackages) that are grouped in RD (research development) lines
  - Today we have 38 active WPs (19 from CERN and 19 from collaborations)
- WPs are of two types: CERN and collaboration
  - For the collaboration a CERN liason is appointed – s/he shall be the entry point to the collaboration
  - When discussing with the collaborations, be sure of always putting the CERN liason in the loop

CERN WPs

- Nb_3Sn conductor (RD line 1)
  - 1.1: Nb_3Sn wire and cable (T. Boutboul)

- HTS (RD line 2)
  - 2.1: REBCO (A. Ballarino)
  - 2.5: Demonstrator DI coil (A. Ballarino)
  - 2.6: Solenoids for the muon collider (L. Bottura)
  - 2.9: Other superconductors (A. Ballarino) (not presented here)
  - 2.16: HTS laboratory (A. Ballarino)

CERN WPs

- Nb_3Sn magnets (RD line 3)
  - 3.1: 12 T cos theta (A. Foussat)
  - 3.4: Technology development program (A. Haziot)
  - 3.5: 14 T block coil (J. C. Perez)
- Modeling (RD line 4)
  - 4.1: Model and software (S. Russenschuck) (not presented here)
  - 4.2: Structural material (C. Garion) (not presented here)
  - 4.3: Insulation (R. Piccin)
  - 4.5: Quench D+P (M. Wozniak, presented by A. Verweij)
  - 4.6: Cryogenic and thermal studies (P. Borges) (not presented here)

CERN WPs

- Infrastructures (RD line 5)
  - 5.1: Test (F. Mangiarotti)
  - 5.2: Conductors (T. Boutboul, presented by J. Fleiter)
  - 5.3: Short model (J. C. Perez) (not presented here)
  - 5.4: Long magnets (S. Izquierdo Bermudez) (not presented here)
  - 5.5: Instrumentation (L. Fiscarelli)

About budget and EVM

- CERN WP leaders propose the technical content, the budget, the deliverables and the timeline
  - They are the owner of the BCs
  - Starting with September 2024, a file per WP with the budget is in EDMS and goes through the double approval of the matrix (see next slide)
  - Successive updates, discussed and agreed by the management, will be then communicated to PO, and approved and stored in the same EDMS

- Note that it is difficult to implement EVM for a R&D program
  - This is also a first brainstorming to see how it can work

About budget and EVM

- We are reviewing the signature rights to implement the following sequence
  - Approval by SL (please check with the WPL)
  - Approval by GL
  - Approval by WPL
  - Approval by PO (consistency with the plan and use of correct BC)
  - Approval by PL (in some special cases I will forward to DH)
- Notes
  - Starting with approval from WPL would have been better, but it is not possible
  - Please check carefully the use of the correct BC!! We have (too ?) many BC, so using the good one is important for correct tracking

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RD line 1: Nb_3Sn conductor

- Besides the 1.1, Nb_3Sn procurement (for the whole collaborations) we have
- WPs for Nb_3Sn development
  - 1.2 Internal oxidation UNIGE (C. Senatore)
  - 1.3 Nb_3Sn development KEK (M. Sugano)
  - 1.18 Internal oxidation studies BAF (A. Leineweber)
- WPs for Nb_3Sn characterization
  - 1.17 Nb_3Sn characterization UTWENTE (A. Kario)
  - 1.19 Nb_3Sn characterization UNIGE (C. Senatore)

RD line 2: HTS non CERN

- WPs for HTS development:
  - 2.1 REBCO development KIT (B. Holzapfel)
  - 2.15 IBS development CNR-SPIN (A. Malagoli)
  - 2.17 REBCO development SOTON (Y. Yang)
- WPs for magnet construction:
  - 2.11 Demonstrator MI coil CEA (T. Lecrevisse)
  - 2.18 HTS 10 T dipole INFN (L. Rossi, under approval)
  - 2.19 REBCO racetrack PSI (D. Araujo)
- WPs for HTS characterization
  - 2.7, 2.14 HTS characterization UTWENTE (A. Kario)

RD line 3: Nb_3Sn magnets

- 3.2 12 T cosθ INFN (S. Farinon)
- 3.11 14 T cosθ INFN (M. Sorbi, under approval)
- 3.6, 3.12 14 T block dipole CEA (E. Rochepault)
- 3.7 14 T common coil CIEMAT (F. Toral)
- 3.14 Stress managed common coil (D. Araujo)

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