Kick-off Meeting of HFM R&D Line 2 Forum on HTS Conductors and HTS Magnet Technologies

Introduction

Outline

- Main Objectives of HFM R&D Programme
- HFM R&D Consortium
- HFM R&D Programme Structure
- Main Challenges Facing the Development of HTS Conductors and Magnet Technologies

HFM Programme – broad goals

- The EU Accelerator R&D Roadmap identifies main objectives for the High Field Magnet Programme:

  - OBJECTIVE 1:

  Design and demonstrate a full-size Nb_3Sn accelerator magnet to demonstrate the maturity of the most advanced technologies today, based on the HL-LHC design, i.e. 12 T magnets, and applying all the lessons learned from the US LHC Accelerator Research programme (LARP), the US High-Luminosity LHC Accelerator Upgrade project (AUP) and the HL-LHC project. The full-size demonstrator also aims to investigate at an early R&D stage the physical and technological effects associated with magnet length.

  - OBJECTIVE 2:

  Explore the limitations of the LTS state-of-the-art technology and push Nb_3Sn magnet technology to its practical limits in terms of ultimate performance, towards the 16 T target targeted by the FCC-hh.

  - OBJECTIVE 3:

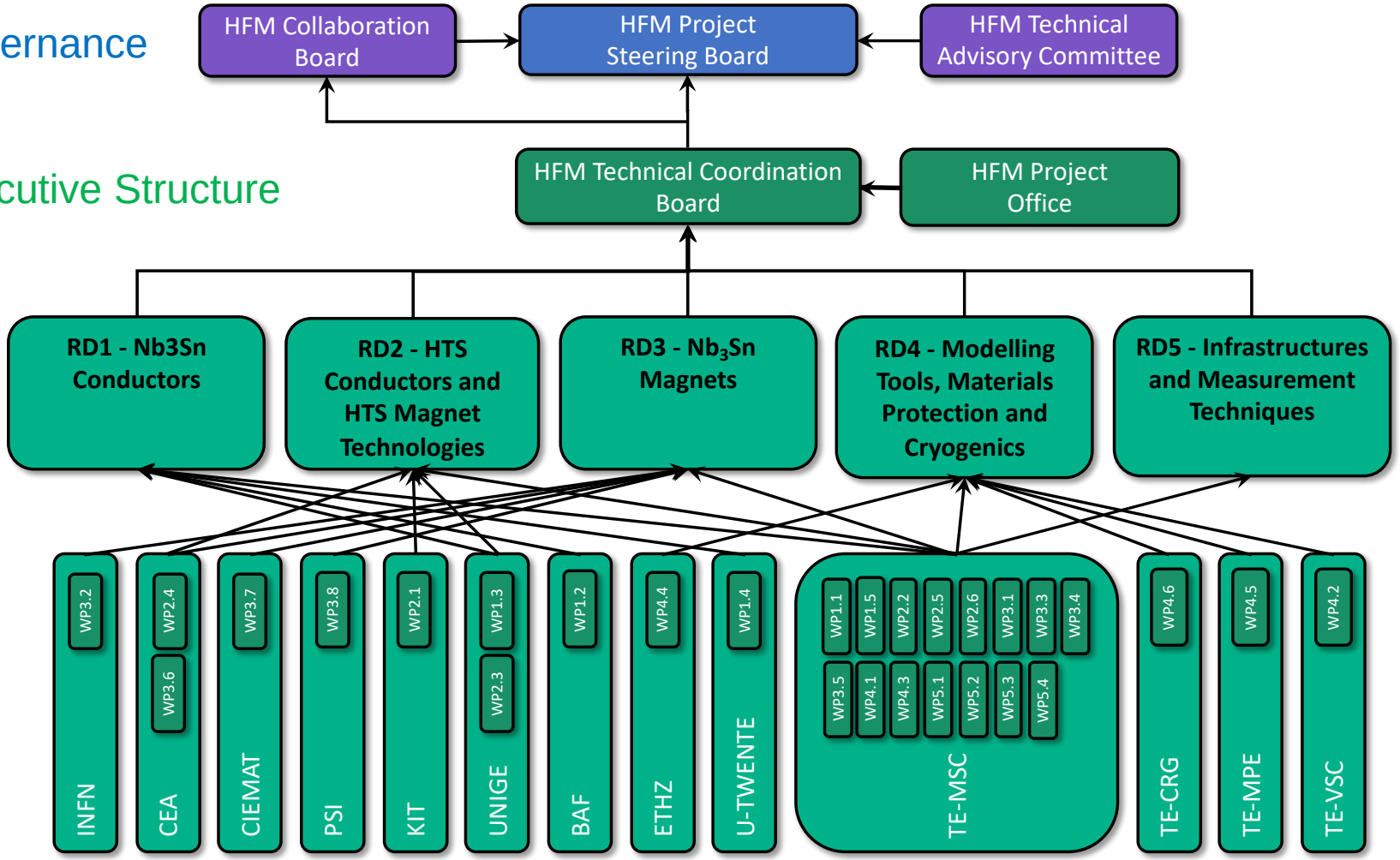
  Explore the capabilities and limitations of state-of-the-art HTS and magnet technology based on these superconductors. Demonstrate the suitability of HTS superconductors for accelerator magnet applications by providing evidence of the use of HTS technology beyond the Nb3Sn range, with a target in excess of 20 T.

HFM R&D consortium
(present main contributors)

HFM Programme Executive Structure

Governance

Executive Structure



R&D Lines and Technical Coordination Board

- All established Work Packages shall coordinate their activities with other contributors in their respective R&D Lines at R&D-Line Fora.
- The R&D Line Coordinators keep an updated version of the integrated R&D Line Deliverable Plan.
- Any changes to the Deliverable Plan are discussed in the Fora and presented and decided in the Technical Coordination Board in a timely fashion.
  - Changes may occur, for example, as a consequence of R&D insights, new collaborations among HFM partners, or the required re-allocation of resources as a function of programme progress and needs.
- R&D Line 2 coordinators: Anna Kario and Amalia Ballarino

Main challenges facing the development of future HTS high-field magnets

HTS Conductors

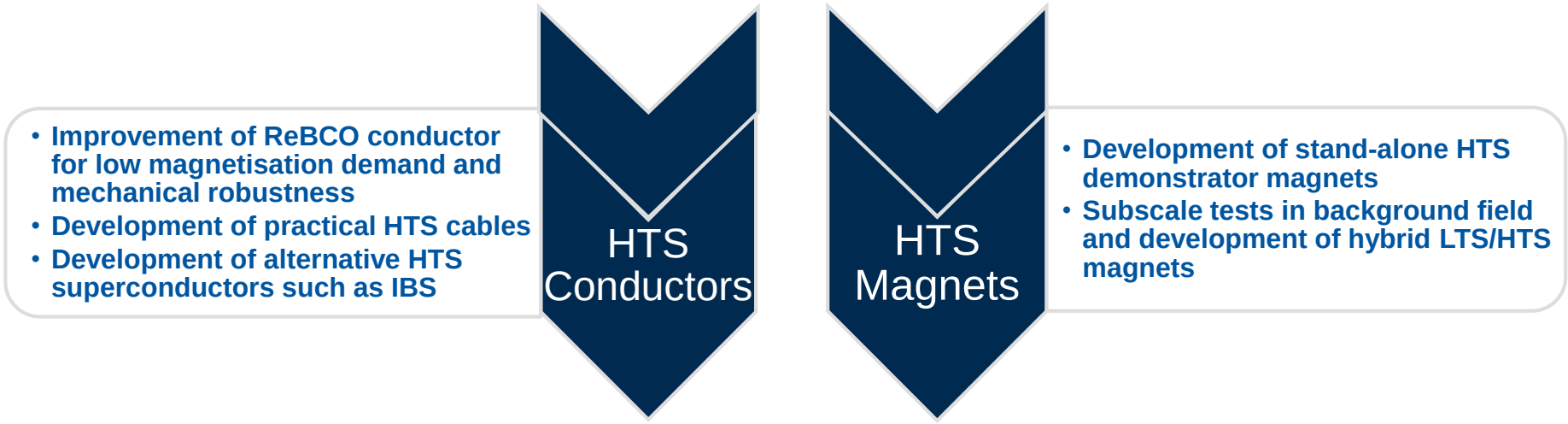
Current main limitations of HTS conductors specific to accelerator magnets:

- ReBCO conductor shear stress sensitivity and degradation
- Large magnetization of ReBCO conductors. Tape conductor shape (rather than multifilamentary wire) creates field errors that may be too large for accelerator magnets
- Magnetic hysteresis, coupling and eddy currents (AC losses) are serious drawbacks of ReBCO tapes and cables. With a substantial modification of the tape architecture (filamentation) ReBCO tapes could comply with losses in Nb3Sn in high-fields (> 10 T)
- Limited ability to bend at small radii of ReBCO conductors, forcing specific structures of magnet coil ends
- Quench protection of accelerator size magnets due to low quench propagation velocity and high stored energy density in coils made of ReBCO as well as Bi-2212
- Uniformity of ReBCO tapes and cables along the length and lot to lot, impacting on magnet protection
- Bi-2212 conductor stress/strain sensitivity and degradation
- Very complex Reaction Heat Treatment for Bi-2212
- …

R&D Strategy and Focus Areas for the HTS Technologies

HTS Conductors and Magnet Technology

- The broader HTS magnet technology, including cable design, coil design, joints, quench detection and magnet protection remains at an early stage of development
- The main focus area is demonstration of the suitability of state-of-the-art HTS conductors for accelerator magnets, providing a proof of principle of HTS magnet technology beyond the capability of LTS Nb_3Sn technology



What is expected from the R&D Lines 2 Forum

- Coordination and harmonisation of the activities of all contributors to the R&D Line 2.
- Close collaboration with other R&D Lines, in particular R&D Line 4.
- Triggering the discussions and driving innovations as part of the integrated R&D Line 2 delivery plan.
- Organisation of R&D Line 2 Forum meetings for experts, as well as regular ”open” meetings for all members of the HFM community.

HFM

High Field Magnets