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HILUMI LHC
FP7 High Luminosity Large Hadron Collider Design Study
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MILESTONE REPORT

CRYOSTAT AND CURRENT LEADS

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Abstract:
This milestone report summarises the conceptual design of the feed-box and current leads for the superconducting links (SC-Link) at P7. Further details are given in the accompanying deliverable report D6.7.
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Executive summary

The report is a high level summary of the P7 feedbox design described in detail in the deliverable report D6.7.

1. INTRODUCTION

Cold powering by Superconducting Links made from high temperature superconducting (HTS) cable assemblies is a technical requirement for the powering layout of the HiLumi triplets at P1 and P5. The distribution feed-box cryostats for the current transfer from the current leads to the superconducting links require a new design to accommodate the many constraints listed below:

1) the mechanical properties of the HTS conductors;
2) the complexity of multi-circuits high current cable assemblies;
3) the helium gas cooling replacing the helium bath:
4) the hydraulic mixing/separation of helium gas for the superconducting links and the current leads.

We propose a conceptual design for the distribution boxes which addresses the requirements listed above and also meets the stringent space constraints for transport and installation. The concept has been developed for LHC P7, where transport and integration constraints are very challenging, and it can be applied to other cold powering systems, like the ones being studied for LHC P1 and P5.

2. DESIGN CONCEPT FOR DISTRIBUTION BOX

The distribution box of the HiLumi HTS links is a cryostat operating in gas at an intermediate temperature of about 25 K. Compared to the LHC distribution boxes, where Nb-Ti conductor is spliced in liquid helium, the challenges for the new distribution boxes are to ensure reliable joining of HTS conductors, appropriate cooling and stable operation in helium gas. The HTS splices must accommodate the mechanical constraints and assure reproducible and low joint resistances. In addition the new distribution box acts as manifold for the hydraulic mixing/separation of the helium gas streams for the superconducting links and current leads under low pressure differentials.

Within the FP7 HiLumi LHC, the focus has been on the distribution box for LHC P7, whose lower current (600 A) superconducting links have already been demonstrated and where a pilot integration in LHC was considered for LS2 in 2018.

In addition to the challenges mentioned above, stringent space restrictions have also been imposed for transport and installation. In close collaboration between CERN and SOTON, a novel concept has now been formed and detailed drawings are on schedule for delivery by mid-2015. The key innovation is the use of modular current leads with flexible HTS cable extensions that can be individually transported in a small footprint and integrated with the distribution boxes in the LHC tunnel, as shown schematically in Fig. 1a. The distribution boxes are designed with full open access for splicing with dedicated tooling to ensure secure mechanical handling for splicing. A 3D rendition of the feed-box is shown in an exploded view in Fig. 1b, more details are found in the deliverable report D6.7.
3. FUTURE PLANS AND CONCLUSION

The plan is to manufacture and verify with tests the concept developed for LHC P7. This will be a valuable learning and scaling process for LHC P1 and P5.

Fig. 1. (a) Schematic view of the current leads via a flexible HTS connection to the feedbox; (b) Exploded view of the feedbox design for P7.
4. REFERENCES


ANNEX: GLOSSARY

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<tr>
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<tr>
<td>HTS</td>
<td>High Temperature Superconductor</td>
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