



# International Review of the Conceptual Design of the Cold Powering system for the HL-LHC Superconducting Magnets

## Welcome and Review charge

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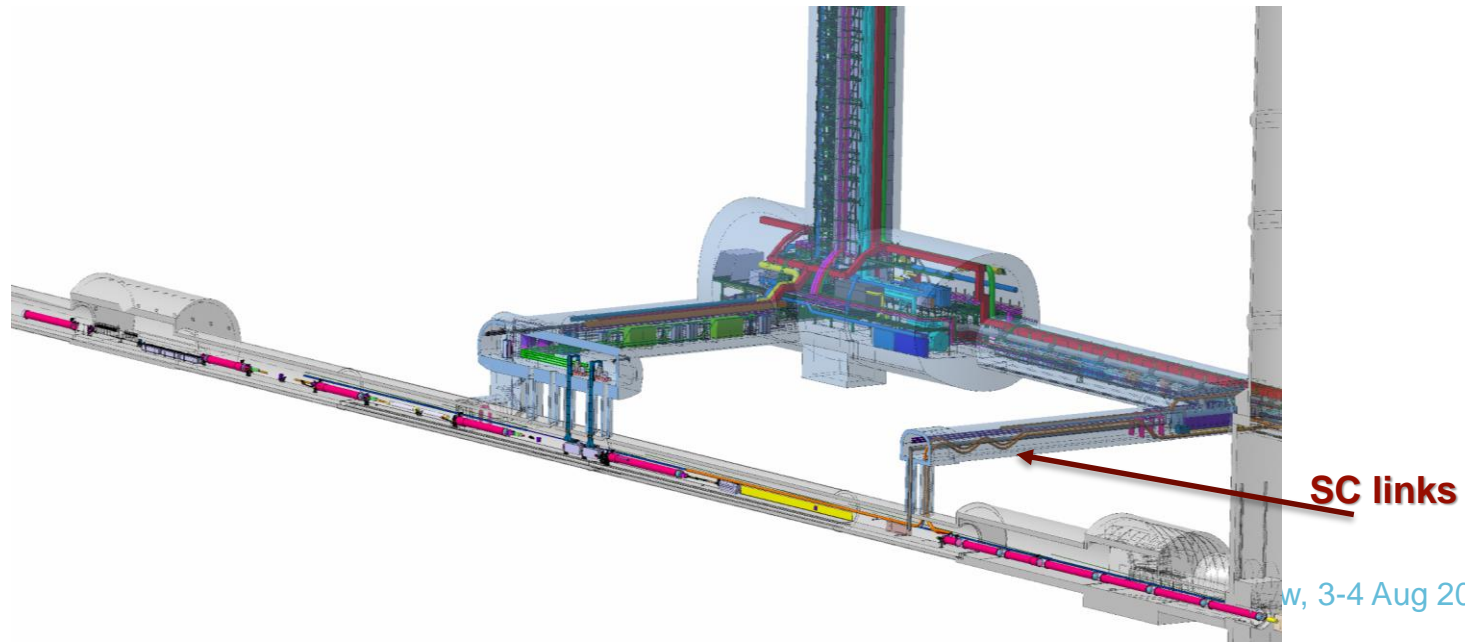


# Mandate and charges - 1

- The High Luminosity LHC (HL-LHC) project has been approved by the CERN Council in the June 2016 session, with a financing profile covering till end of installation in 2026. For the first time the powering system is based on high current long ( $>100$  m) superconducting lines (called Superconducting Links) employing superconductor operating in He gas, well above the usual LHe or HELL temperatures.
- The HL-LHC cold powering (WP6A in the Project Breakdown) is a complex system that has to enable transferring about 100 kA into the superconducting magnets of the upgraded LHC insertion magnets. The system is now in an advanced phase of design; **MgB2 SC links basic concept have been demonstrated about two years ago in a 20 kA - 20 m long demonstrators**, while a long prototype ( $>60$  m) of final size and current is under constructions. **Other features of the system, like joint box, cold distribution box, etc. are being designed or under validation** or in conceptual phase.

# Mandate and charges - 2

- Since the early design phase, end 2010, we decided to explore the MgB<sub>2</sub> (with an eye on HTS!) potential for the links, that at beginning were 300 m long, 100 m high, and 150 kA capability, to benefit of the large temperature margin and to make a completely different (from LHC) Cold Powering system, with no liquid in the CL box and removing CL box (DFBs) from LHC tunnel.
- *(there was also a 600 m long horizontal link, rated for 25 kA, for P7, for which was foreseen in 2013-14 one prototype: the cancellation of that link in 2015 has required that the prototype was redirected toward the big IT link)*
- With the double decker solution adapted in 2015, the link became shorter (100 m) and with a reduced level gap (~15 m). Then, following various circuit reduction the current is reduced to 100 kA.



# Mandate and charges - 2

- In addition, also due to various changes in the general powering scheme, some of them rather recent, the design and optimization of the full system still requires some time. The system must be fully designed and validated within 2018 to allow launching production of components for the final production in 2019 and 2020. The design must also live with the constraints given by the already defined technical infrastructure and integration, which at this stage cannot be changed. A test of a full, prototype system in the Inner Triplet String is foreseen in 2021-23, and installation in LHC P1 and P5 is foreseen in 2024 and early 2025.
- The present review has been called to examine the preliminary design, the main choices, to assess the presence of possible show-stoppers and to see if interfaces between WP3 (Magnets) and WP6B (warm powering), as well as Cryogenics and Circuit protection, are well defined. The review will cover both technical aspects and general integration, as well as the global planning.

# Review Panel

## Members of the Review Panel:

- Akira Yamamoto (KEK-CERN, Chair)
- Maciej Chorowski (WUT)
- Chen-yu Gung (ITER)
- Joe Minervini (MIT)
- Davide Tommasini (CERN)
- Pierre Vedrine (CEA)

It is important to note the good overlap between this review panel and ones of the Circuit Reviews (International review last year, and an Internal review in March 2017), as well as with the Magnet Reviews.

## Questions to be answered (1/2)

- Is the technical scope of the Cold Powering System well defined and interfaces with adjacent equipment well clarified, also regarding installation? And in particular is the design and validation of the components closely linked to the cold powering (for example: bus bars, quench detection and protection, warm powering, etc.) sufficiently defined to allow finalization of the design of the Cold Powering System?
- Is the general design correct and adequate to meet the scope? Is the design safe also with respect to the boundary conditions given by the magnets and circuit protection system?
- Is the basic design of each components or subsystem adequate to the scope with reasonable margins? For the items still under definition, is the plan to finalize the design sound?

## Questions to be answered (2/2)

- Is the plan to complete the design, to develop demonstrators for each critical item (for example splices among different materials, cabling of many large conductors, handling of the heavy and long SC links, e.m. coupling inter-circuit at acceptable level, etc.) properly done and sound? Are any critical design and technological developments that are still missing or in severe delay ?
- Is the test plan including the IT String test adequate (without too many details at this early stage)?
- Are there issues that have been neglected or underestimated?

# Various

- While the cost and resources are not in the scope of the review (they have been reviewed by an international panel in HL-LHC C&S reviews on March 2015 and October 2016), the reviewers may comment on the level of resources allocated to design , prototyping and validations, as well as on the schedule.
- (for your info next C&SR3 is on March 2018)
- The review panel reports to the HL-LHC Project Leader and the panel chair is required to deliver a written report within one month after the review.



# Practical details

- <https://indico.cern.ch/event/643197/timetable/#20170703>
- Monday 3.07 : [30-7-18]
  - 9:00 - 12:30 : Presentations
  - 10:45 – 11:15 : Coffee break with group picture
  - 12:30 - 14:00 : Lunch
  - 14:00 - 18:15 : Presentations
- Tuesday 4.07 :
  - 8:30 – 10:00 : Visit to 927 and SM18 (on invitation only)
  - 10:00 – 12:00 : Answers to questions [30-6-19]
  - 14:00 - 17:00 : Closed session and answers to questions [30-7-18]
  - **17:00** ***Close out [30-7-18]***



***Wish you a productive review***

***Thanks to JP Tock for coordinating  
the review and to Celine for the  
secretariat & logistics support***