First feedback and comments on HL-LHC IT STRING Review recommendations

M. Bajko, M. Pojer

HL-LHC IT STRING Coordination

Outline of my talk

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Scope:

The review panel has been convinced that the tests performed on the IT-string will be too late to provide feedback on the series production of the main equipment. However, the review panel stresses the importance of the IT-string test as an intermediate milestone for the HL-LHC project. This test should be focussed to validate the collective behaviour of the new technologies developed for the HL-LHC project. Moreover, the IT-string will be the only place where all magnets will be tested together, including the magnets tested by the HL-LHC collaborations, and together with their complex new powering system. In particular, the collective behaviour of Nb_3Sn cryo-magnet string coupled with an MgB_2 sc-link should be investigated with emphasis on:

- the possible cross-talk and coupling effect of different circuits,
- the understanding of the flux-jumps and their impacts on the strategy for the machine protection system and for the power-converter controls,
- the effectiveness of the synchronization between the quench protection system of various magnets and of the sc-link,
- the collective impact of the CLIQ system,
- the fully remote alignment system,
- the thermo-mechanical validation of the system,
- the identification of possible unknown-unknowns.

Recommendation 1: Focus the test on the IT-string to validate the collective behaviour of the new technologies developed for the HL-LHC and study/propose mitigation measures, if any.
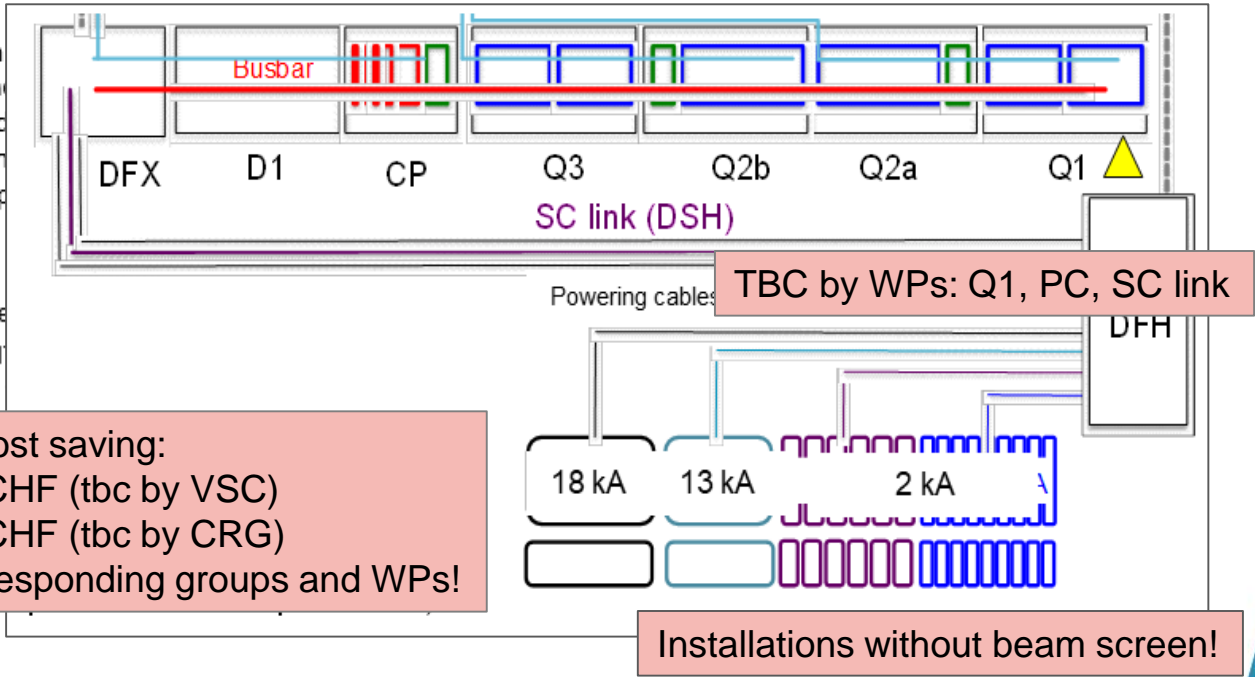
In line with the planned scope

Configuration:

The review panel supports to keep the full magnet-circuit configuration as the baseline configuration, which includes the Q1, Q2A, Q2B and Q3 low-beta quadrupoles, a corrector package, a D1 beam-recombination dipole and the cold powering equipped with the final machine protection, warm powering, data analysis and controls systems. If prototypes are used, a study should be conducted to prove that they would have the same behaviour than series components and that they would not be identified as the main cause of a non-conforming test.

The review panel has not identified a
Concerning the beam-screens, the th
the impact on the magnetic field and
The integration of the beam-screen
dedicated representative mock-up
interconnection procedure.

Recommendation 2: Confirm that the
Recommendation 3: Simplify the I
collective behaviour or which can be

Estimated cost saving:
    580 kCHF (tbc by VSC)
    100 kCHF (tbc by CRG)
TBC by corresponding groups and WPs!

TBC by WPs: Q1, PC, SC link

Installations without beam screen!

Busbar

DFX   D1   CP   Q3   Q2b   Q2a   Q1

SC link (DSH)

Powering cables

DFH

18 kA   13 kA   2 kA

Resources and budget:

According to the HL-LHC Budget Officer, a total cost saving of 1 MCHF should be needed to respect the total allocated budget at completion of the WP16. The review panel was not able to assess if a reduced magnet configuration will be sufficient to validate the collective behaviour of the new technologies. In addition, the full exploitation of the IT-string should reduce the commissioning time and consequently the resources required during the LS3 by the other Workpackages (e.g. WP3, WP6A, WP6B, WP7...).

The resources for the academic support to the IT-string tests are included and identified in the WP16; however, the resources required for the operation of the IT-string are outside the WP16, supplied by the Departments and not specifically identified.

Recommendation 4: Prepare a cost – benefit matrix for various IT-string configuration options.

Recommendation 5: Analyse possible cost reduction on other Workpackages due to the full exploitation of the IT-string.

Recommendation 6: Identify the resources required for the IT-string operation and maintenance (helium, spares, supervision, industrial support...) and ensure that they are included in the Department MPP.

- If these recommendations are retained by the project, will necessitate some time to work on it.
- …. Recommendation 4: is overlapped with recommendations 1
- …..Recommendation 5: in our opinion this is to be done by the project office
- …..Recommendation 6: has been followed up by the TE department. To be confirmed by TE,BE department that all necessary resources are (found) introduced by the groups into MPP.

Schedule:

The master schedule of the IT-string presented to the review panel shows 10 months of installation starting September 2020, followed by 17 months of hardware commissioning and studies ending by end 2022. One year of operation has also been foreseen in 2023 as a margin for additional tests. The review panel stresses the need for disentangling operation and experimental programme and to contain the experimental programme to a bare minimum. The test programme shows as well a large number of resistive transitions provoked at high current.

Recommendation 7: Limit the IT-string test duration to end 2022 and concentrate the 2023-year resources on the LS3 preparation.

Recommendation 8: Confirm that the magnet design is compatible with the proposed quench programme.

Recommendation 9: Create an IT-string programme steering committee with the mandate to prioritize, filter and validate the requests, to guarantee that the IT-string will remain a safe tool, and to prioritize the requests within the allocated test period and budget. This committee should report to the HL-LHC TCC.

To be confirmed by WP3

Experimental program = Studies

The number of resistive transitions will be re-estimates as in every quench provoked in a high current magnet all others will quench and as a consequence the number of provoked quenches can be reduced.

- 6 months possible
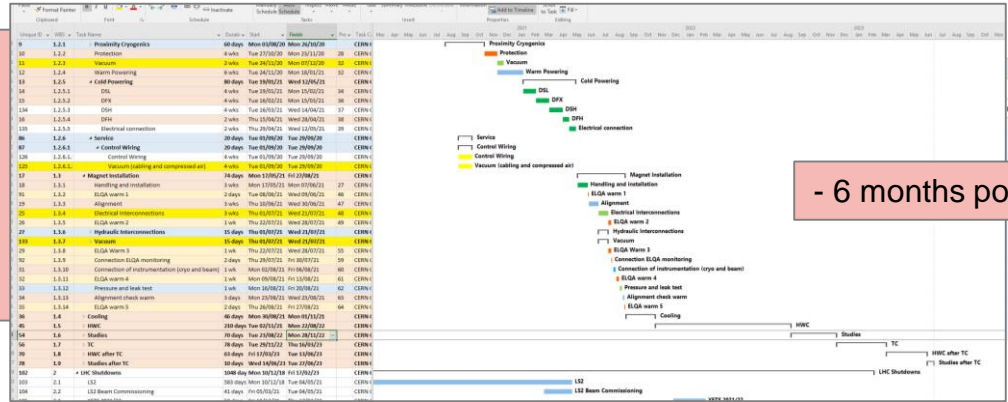
Project organization:

The IT-string will be an opportunity to put people together and to define interfaces at an earlier stage. Consequently, the WP16 requires a large transversality with the HL-LHC project workpackages and with the support Groups. WP16 should be empowered by the management and the WP leadership should have a strong connection with the Project Office and with the Department Heads concerned. It is also important that the IT-string timeline is respected and that all technical and planning issues regarding the IT string should be solved in the TCC first. Some review-panel members advised to give a stronger mandate to the WP16.

Recommendation 10: The HL-LHC Project Leader and the concerned Department Heads should carefully follow the readiness of the WP16 with the help of the Technical Coordination Committee and the Project Steering Meeting. Review the situation in 6-12 months for possible actions.

To be worked out with the management (project and line) the next possible review content and dates to insure an optimum follow up.

I personally wish to thank for all WP members having worked till now with us (Mirko and myself) for their work and constructive spirit which is a great help while WP16 is trying to coordinate test for other WPs ….aswell as the support of the HL-LHC project leader and office.
I look forward the next milestone of the HL-LHC STRING !