HL-LHC IT String Day V

Report of Contributions

https://indico.cern.ch/e/1557008

Contribution ID: **1** Type: **not specified**

Feedback from the HL-LHC IT String Day IV and scope of the HL-LHC IT String Day V (WP1 / ATS-DO)

Tuesday 9 September 2025 08:30 (20 minutes)

This introductory talk will introduce the scope of todays 5th IT String day in light of the recent findings. The talk will also recap and reference the follow-ups done based on the recommendations of last years event, which was focused on achieving the completion of the IT String installation and prepare it for operation by the end of 2025.

Author: ZERLAUTH, Markus (CERN)

Presenter: ZERLAUTH, Markus (CERN)

Session Classification: General session

Contribution ID: **2** Type: **not specified**

HL-LHC IT String general status, budget, schedule (2025 vs 2024) (WP16 / TE-MPE)

Tuesday 9 September 2025 08:55 (20 minutes)

This talk will present the status of WP16. It will begin with an overview of the budget and organisational aspects, which remain in line with expectations and represent less than 1% of the overall project cost, despite a reduced SF team. The current status of activities will then be reported: all equipment has been installed, connected, and passed quality control, with the exception of the cold masses Q2a and Q3. The readiness for operation will be described, including the organisation of activities, the definition of key roles, the agreement with Japan, completed safety analyses and risk mitigations, and the advanced state of controls and software. The talk will also review the schedule situation: until July 2025, activities were fully in line with the planning and aimed for cold powering by the end of the year, but the present non-conformity prevents the establishment of a new reliable schedule. Finally, the HL-LHC IT string leak issue will be presented, covering detection, root cause, side effects, localisation, and the ongoing repair studies, with the current preferred solution being an in situ repair with new bus bars in the NC line.

Author: BAJKO, Marta (CERN)

Presenter: BAJKO, Marta (CERN)

Session Classification: General session

Contribution ID: **3** Type: **not specified**

HL-LHC IT String Safety (WP16/TE-MPE)

The HL-LHC IT String safety strategy including the responsibilities will be recalled. The safety aspects applied during installation will be detailed. Ongoing preparatory documents for the safety during operation will be presented. The safety aspects and constraints specific to the operation of the HL-LHC IT String in the SM18 building will be highlighted. Last but not least, applied on-site safety examples accompanied by lessons learned will be shown.

Author: BOZZINI, Davide (CERN)

Presenter: BOZZINI, Davide (CERN)

Session Classification: General session

Contribution ID: **4** Type: **not specified**

HL-LHC IT String Technical Coordination and Safety (WP16 / ATS-DO)

Tuesday 9 September 2025 09:20 (20 minutes)

The presentation will cover the methodology and organizational structure behind the technical coordination of the HL-LHC IT String facility, which is nearly to completion. It will provide an in-depth update on the progress of the on-site construction and commissioning activities. Key lessons learned from the IT String's construction and commissioning will be shared, covering the technical challenges we faced, the schedule changes, and the coordination of concurrent activities. Additionally, the safety strategy implemented during construction and commissioning will be revisited and the proposed approach for operation will be presented.

Presenter: BOZZINI, Davide (CERN)

Session Classification: Lessons learned

Contribution ID: **5** Type: **not specified**

Cold powering system (WP6A/TE-MSC)

The presentation will address the following topics:

- Performance of the Prototype Cold Powering system
- Completed installation activities and lessons learnt
- Upcoming activities and interfaces

Author: LECLERCQ, Yann (CERN)

Presenter: LECLERCQ, Yann (CERN)

Session Classification: Lessons learned

Contribution ID: **6** Type: **not specified**

Warm powering equipment, control cabling and other services installation (WP16/TE-MPE)

The Warm Powering equipment, which includes the Power Converters (PC), Energy Extraction systems (EE), Circuit Disconnector Boxes (CDB), and Powering Interlock Controllers (PIC), is nearing the final stages of installation. This process also involves the setup of control cables, AC power supply, and the technical Ethernet network. The goal is to prepare for the Individual System Tests and Short Circuit Tests. This presentation will describe the installation process and share lessons learned from overcoming various challenges and issues.

Presenter: BLANCHARD, Sebastien (CERN)

Session Classification: Lessons learned

Contribution ID: **7** Type: **not specified**

Installation and Interconnection of the Magnet Systems (WP3 / TE-MSC)

Tuesday 9 September 2025 09:45 (20 minutes)

In this presentation, we provide a summary of the installation of the cryomagnets for the IT string, along with the main lessons learnt. Special focus is placed on extracting the most important information relevant to the inner triplet installation during Long Shutdown 3 (LS3).

We begin with a brief introduction to the magnet system and its interconnections. The initial installation plan is then outlined, including the interlink (DCM). Following the interconnection sequence, we describe, step by step, the main interventions and lessons learned: (i) Lines N insertion, (ii) Q1 to D1 connection, (iii) DCM connection, and (iv) Jumper connection. Finally, quality assurance, non-conformities, and the corresponding mitigation plans are also presented.

Presenter: FERRADAS TROITINO, Jose (CERN)

Session Classification: Lessons learned

Contribution ID: **8** Type: **not specified**

HL-LHC IT String individual system & short circuit tests (WP16/TE-MPE)

The Individual System Tests (IST) and the Short Circuit Tests (SCT) are important intermediary steps in the Hardware Commissioning (HWC) of the HL-LHC IT String. This talk gives an overview of the different IST and SCT planned for the warm powering system, the cryogenic system, the quench detection, and protection systems and the associated procedures. Moreover, the quality control steps and quality assurance of HL-LHC IT String systems will be shown in the presentation. These steps and procedures will also be a cornerstone to prepare the work for the HL-LHC.

Presenter: YAMMINE, Samer (CERN)

Session Classification: Upcoming main activities

Contribution ID: **9** Type: **not specified**

SC link system installation (WP6A/TE-MSC)

The IT Cold Powering System is presented with its main components. The experience acquired during the assembly of the first Cold Powering System in 2023 is presented with respect to its added value for the upcoming STRING installation. After presentation of the proposed installation sequence, the workplan and the list of tasks until readiness for installation is shown.

Presenter: LECLERCQ, Yann (CERN)

Session Classification: Upcoming main activities

Contribution ID: **10** Type: **not specified**

Magnet Installation and Interconnections (WP3/TE-MSC)

The presentation gives a status of the cryo-magnets for the IT string and a brief sequence of the cryo-magnets installation and connection including the interlink (DCM). The results of critical steps of the magnet connection made on representative mock-up are detailed and the first intervention on the SQXL jumper for the magnet interface is also described. The specific tooling for the interconnection activities is detailed. The known non-conformities on the magnets and the mitigation plans are presented.

Author: LE NAOUR, Sandrine (CERN)

Presenter: LE NAOUR, Sandrine (CERN)

Session Classification: Lessons learned

Contribution ID: **11** Type: **not specified**

Vacuum System Configuration & Leak Tightness Results (WP16 / TE-VSC)

Tuesday 9 September 2025 10:35 (20 minutes)

This presentation introduces the IT string insulation vacuum system and summarizes the status of the leak detection and tightness validation programs. After a brief reference to the vacuum equipment layout, we provide details about the vacuum equipment configuration during the commissioning phase, linking it to the recommendations and comments received during the IT string day IV. Then we provide an overview of the leak testing activities and their status, with focus on the leak/s found at the cold mass circuit, the ongoing activities, and the pending actions. In view of LS3, a series of lessons learnt are also outlined.

Presenter: PEREZ ESPINOS, Jaime (CERN)

Session Classification: Lessons learned

Contribution ID: **12** Type: **not specified**

Control Layers & Software for Operations (WP16 / TE-MPE)

Tuesday 9 September 2025 15:55 (20 minutes)

The status of the control systems and their interfaces is presented with a particular focus on the software layers essential for the powering and magnet protection tests during the IT String validation program. Ensuring integration of the new HL-LHC device types and their operational readiness requires close collaboration between development teams, equipment owners and the IT String operation team. The Dry Run tests aim at validating the functionalities of new device types and the HWC Powering applications and services.

Author: BLANCHARD, Sebastien (CERN)

Presenter: BLANCHARD, Sebastien (CERN)

Session Classification: Status & Readiness for Operations

Contribution ID: **13** Type: **not specified**

Machine Protection Equipment (WP7 / TE-MPE)

Tuesday 9 September 2025 14:45 (20 minutes)

This presentation will give an overview of the status of the installation and testing of protection equipment in the IT String and its controls integration. Furthermore, the foreseen tests at before and after cool-down will be addressed.

Presenter: WOLLMANN, Daniel (CERN)

Session Classification: Status & Readiness for Operations

Contribution ID: **14** Type: **not specified**

Closed session of the advisors

Tuesday 9 September 2025 17:15 (20 minutes)

Session Classification: Closed Session

Contribution ID: **15** Type: **not specified**

Visit to the HL-LHC IT String

Session Classification: Closed Session

Contribution ID: **16** Type: **not specified**

Status of cryomagnets for the HL-LHC IT String (WP3/TE-MSC)

Presenter: Dr TODESCO, Ezio (CERN)

Session Classification: Upcoming main activities

Contribution ID: **17** Type: **not specified**

AccTesting for the HL-LHC IT String (WP7/TE-MPE)

The Accelerator Testing framework has been used successfully to facilitate the execution and analysis of thousands of tests during the hardware commissioning campaigns of LHC and during its operations to qualify the powering systems. The presentation covers the extensions of AccTesting and its ecosystem needed to support the commissioning of IT String facility. Describes the framework that is used for the interactive analysis of the powering tests and its readiness for IT String.

Presenter: MNICH, Aleksandra (CERN)

Session Classification: Status & Readiness for Operations

Contribution ID: **18** Type: **not specified**

Finalization of the Cold Powering System (WP6a / TE-MSC)

Tuesday 9 September 2025 11:40 (20 minutes)

The Cold Powering System of the ITS String was installed on the IT String 2024 –2025. This presentation covers:

- Overview of the Cold Powering System
- Status of the Cold Powering System
- Activities since String Day IV
- Open points

Presenter: Dr BARTH, Christian (CERN)

Session Classification: Lessons learned

Contribution ID: **19** Type: **not specified**

HL-LHC IT String Quality Assurance & Control (WP16/TE-MPE)

This presentation provides a comprehensive overview of the Quality Assurance and Control processes implemented in the HL-LHC IT String. It describes the management of non-conformities related to the test stand, adhering to the policies established by the HL-LHC Project. It explains the tracking process of the validation tests conducted during installation and commissioning of the equipment. Additionally, it shows the new tools that have been generated to manage quality during operations.

Author: HERRERO ALVAREZ, Lucia (CERN)

Presenter: HERRERO ALVAREZ, Lucia (CERN)

Session Classification: General session

Contribution ID: **20** Type: **not specified**

Electrical Quality Assurance for the IT String (WP7/TE-MPE)

The presentation will address the following topics:

- Status of the collaboration, (procedures, equipment, software…)
- Feedback of the experience of ElQA in the individual magnets and ScLink
- Plan and procedures for the IT String activities

Author: BEDNAREK, Mateusz Jakub (CERN)

Presenter: BEDNAREK, Mateusz Jakub (CERN)

Session Classification: Lessons learned

Contribution ID: **21** Type: **not specified**

Installation & Commissioning of Full Remote Alignment System (WP19 / BE-GM)

Presenter: BARBARROUX, Vincent Thomas (CERN)

Session Classification: Lessons learned

Contribution ID: **22** Type: **not specified**

Experience & Results on Electrical Quality Assurance (WP7 / TE-MPE)

Presenter: WEST, Gregory Hugh

Session Classification: Lessons learned

Contribution ID: **23** Type: **not specified**

Cryogenics for Operations (WP16 / TE-CRG)

Tuesday 9 September 2025 14:20 (20 minutes)

The cryogenic system of the HL-LHC IT String was successfully commissioned in 2023-2024 in a standalone mode (without magnets and SC-link). In 2024-2025 the cryogenic system was prepared for the commissioning and operation of the HL-LHC IT String including all its components. This presentation covers:

- Follow-up on the comments from String Day IV
- Status of the cryogenic system
- Preparations for cryogenic commissioning
- Planned cryogenic commissioning and operation of HL-LHC IT String

Presenter: ONUFRENA, Aleksandra (CERN)

Session Classification: Status & Readiness for Operations

Contribution ID: **24** Type: **not specified**

Warm Powering Equipment (WP6b / SY-EPC)

Tuesday 9 September 2025 15:30 (20 minutes)

This warm powering equipment talk presents the progress of the WCBB & WCP design and especially how the ElQA issue has been solved. Afterwards, the status of the HL-LHC String equipment is presented, in particular the restarting tests before the HWC of the HL-LHC String facility. Finally, the impacts of the new delay and the constraints on LHC operation and LS3 are discussed.

Presenter: THIESEN, Hugues (CERN)

Session Classification: Status & Readiness for Operations

Contribution ID: **25** Type: **not specified**

Overview and Parameters for the HL-LHC IT String Operation (WP16 / TE-MPE)

Presenter: YAMMINE, Samer (CERN)

Session Classification: HL-LHC IT String Validation Program

Contribution ID: **26** Type: **not specified**

Analysis Software for the HL-LHC IT String Validation Program (WP16 / TE-MPE)

Tuesday 9 September 2025 16:20 (15 minutes)

This presentation will introduce the role of the **Analysis Software** within the HL-LHC IT String Validation Program. The talk will highlight how this software is used to process and interpret data from the Hardware Commissioning **(HWC) powering tests**, which are essential to verify both the powering and protection systems of the new HL-LHC magnet circuits, as well as the overall circuit performance. Finally, a comparison will be made between the analysis approach developed for the IT String and the well-established methods already applied in the LHC, outlining the specific challenges and particularities of this validation campaign.

Presenter: HERRERO ALVAREZ, Lucia (CERN)

Session Classification: HL-LHC IT String Validation Program

Contribution ID: **27** Type: **not specified**

Test of the HL-LHC Beam Operation Cycles in the HL-LHC IT String (WP2 / BE-OP / TE-MSC)

Presenter: HOSTETTLER, Michi (CERN)

Session Classification: HL-LHC IT String Validation Program

Contribution ID: **28** Type: **not specified**

N Lines Busbars Activities in the IT String (WP3 / TE-MSC)

Tuesday 9 September 2025 11:05 (25 minutes)

This report provides an overview of the busbar and cold mass activities, with a focus on the work related to the Line N system. It begins with a general introduction to the layout of the busbars and cold masses, followed by a summary of the preparatory steps for Line N, its insertion process, and the key lessons learned.

A proposed modification to the busbar layout is then presented, aimed at enabling the operation of the IT string despite the presence of leaks in N line flexibles. This proposal considers both mechanical integration constraints and cable availability. The thermo-mechanical behavior of the busbar system is discussed in detail, with emphasis on the impact of thermal contraction under the current configuration. An ongoing study attempting to characterize the cable through mechanical measurements is also described, along with its limitations. Potential technical mitigation measures are outlined.

Finally, the report introduces initial ideas for a possible upgrade of the busbar system for the High-Luminosity LHC tunnel installation, highlighting how the insights and lessons learned from the IT string motivate future developments.

Presenter: BAUDIN, Lucie (CERN)

Session Classification: Lessons learned

Contribution ID: **29** Type: **not specified**

Proposed Solutions for the IT String Magnet Circuits and Parameters for Operation (MCF / WP16 / TE-MPE)

Tuesday 9 September 2025 16:40 (25 minutes)

The presentation recalls the IT String Validation Program phases and strategy including the Quality Control/Assurance steps, individual system tests, powering tests and string-specific tests. The presentation later shows the reasons behind the adequacy in terms of quench performance of considered solution on the magnet circuits following the String leak. Finally, the parameters for operating the HL-LHC IT String are shown. These parameters for cryogenic operation, powering, quench detection, and beam operation cycles are detailed.

Presenter: YAMMINE, Samer (CERN)

Session Classification: HL-LHC IT String Validation Program

Contribution ID: **30** Type: **not specified**

Experience & Results on Electrical Quality Assurance (WP7 / TE-MPE)

Tuesday 9 September 2025 13:55 (20 minutes)

The ELQA campaign at the Inner Triplet String Facility aims to validate circuit integrity ready for safe operation, whilst also providing a valuable opportunity to collect reference data to support more reliable results validation and assist potential future fault localisation. The work has also allowed the ELQA team to refine procedures, equipment, software, and reporting based on real operational experience. The broad range of activities carried out by the ELQA team has been largely successful and prompt, while also revealing important lessons to further optimise systems and processes. This presentation will highlight these activities and the lessons learnt, as well as show how they are helping the ELQA team prepare a robust and efficient programme ready for HL-LHC installation.

Presenter: WEST, Gregory Hugh

Session Classification: Lessons learned

Contribution ID: **31** Type: **not specified**

Installation & Commissioning of Full Remote Alignment System (WP19 / BE-GM)

Tuesday 9 September 2025 13:30 (20 minutes)

The presentation will address the following topics:

- FRAS installation activities.
- FRAS commissioning

The presentation will cover the FRAS installation activities on the magnet line as well as the infrastructure for acquisition, control systems and quality. Key lessons learnt will be presented. FRAS commissioning activities and results will be presented. First lesson learnt will be presented and status given.

Presenter: BARBARROUX, Vincent Thomas (CERN)

Session Classification: Lessons learned

Contribution ID: **32** Type: **not specified**

HL-LHC IT String Validation Program