Installation IT String in SM18

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Y. Leclercq, H. Prin, R. Principe

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- Description of MSC activities for IT String
  - Initial conditions considered
  - Main activities for magnets Q1→D1 interconnection
  - Main activities for DCM installation and connection
  - Main activities for the cryo-magnet jumpers

- Planning and resources

Activities description

The initial conditions considered are:

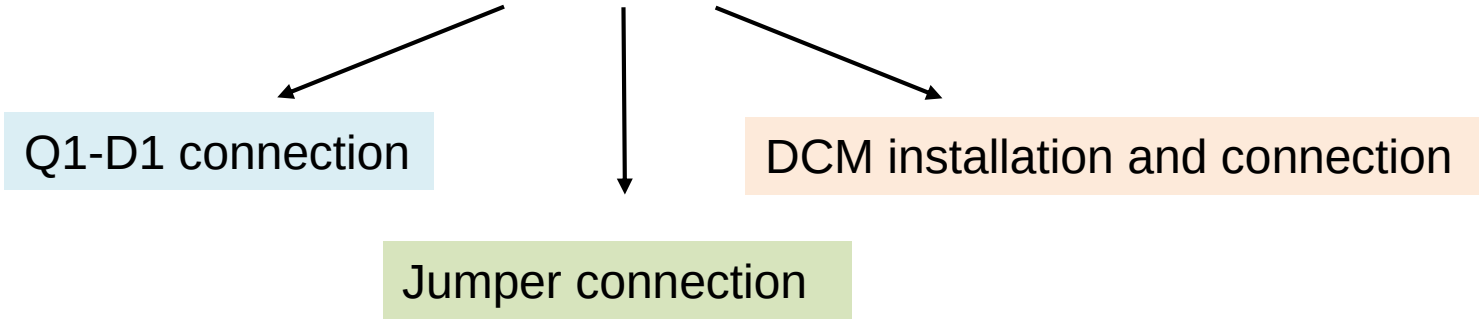
- Plugs on SQXL jumpers are removed
- Ground fixations are ready for installation of jacks, anchors and DCM frame (EN-ACE action)
- Jacks are in place
- Q1 to D1 magnets are in place and aligned
- The anchors are fixed and tightened
- ELQA tests on each individual magnet are taken as reference
- DCM and possibly its frame are **not** in place.
- DFX can be present (WP6A)

Activity : N lines pulling

N lines pulling

- QC: ElQA test of N lines on the reels
- Cables on reel at DCM position. Installation of winch and pulleys
- Line N1 pulling : 18kA superconducting cables from D1 to Q2a.
- Line N2 pulling : 2kA superconducting cables from D1 to Q2a.
- QC: ElQA test with N lines in position in the cryomagnets

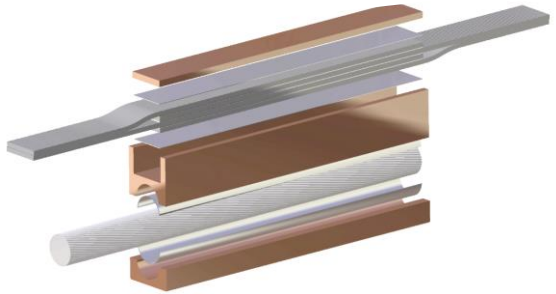
From this step three activities in parallel :



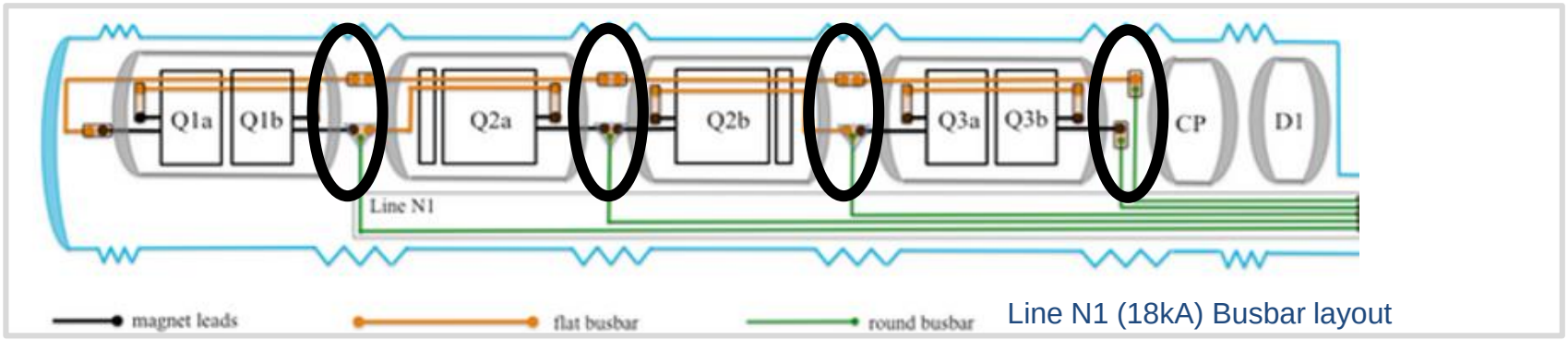
Activity: Q1 to D1connection

Once the N lines are in place and validated (ELQA), starts the splicing work.

- 18 kA splices soldering : 8 splices
  - QC : resistive and dimension check (tbd)



Magnet leads to 18kA cable join

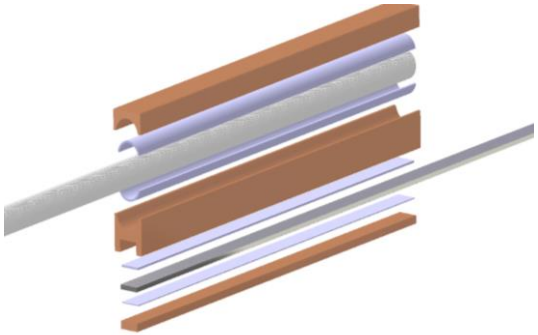


Line N1 (18kA) Busbar layout

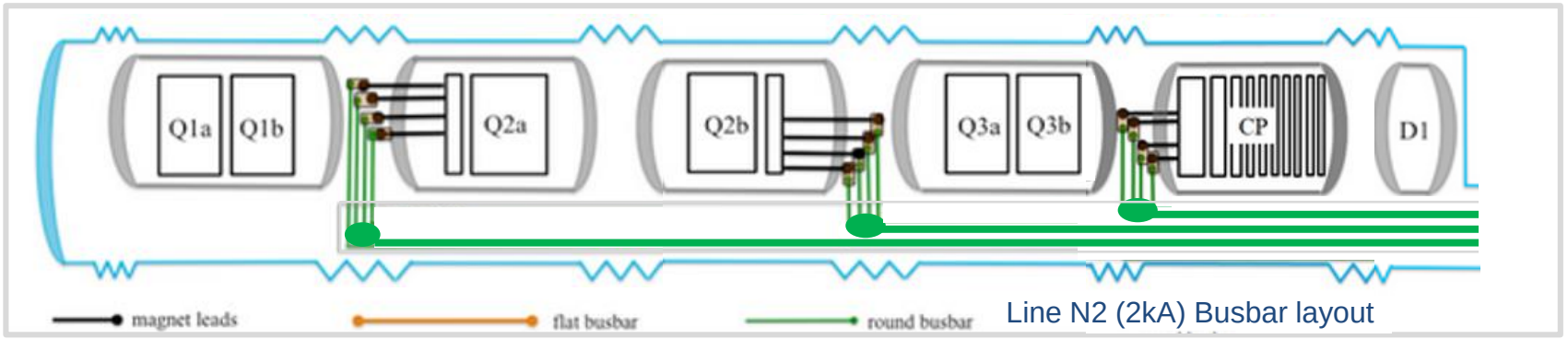
Activity: Q1 to D1connection

Once the N lines are in place and validated (ELQA), starts the splicing work.

- 18 kA splices soldering : 8 splices
  - QC : resistive and dimension check (tbd)
- 2 kA splices soldering : 12 splices
  - QC : resistive and dimension check (tbd)



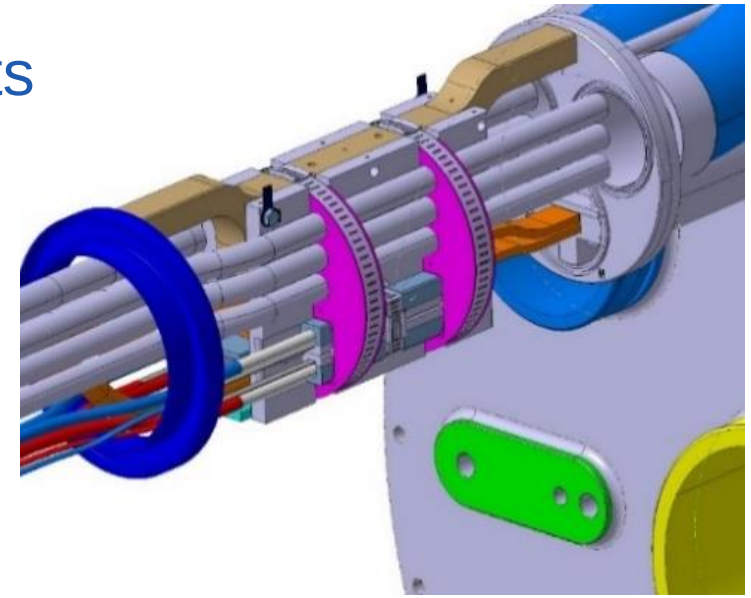
Magnet leads to 2 kA cable join



Line N2 (2kA) Busbar layout

Activity: Q1 to D1connection

- Splice insulation
  - QC (tbd)
- Installation of the fixe points
  - QC (tbd)
- Eccobond injection
  - QC (tbd)

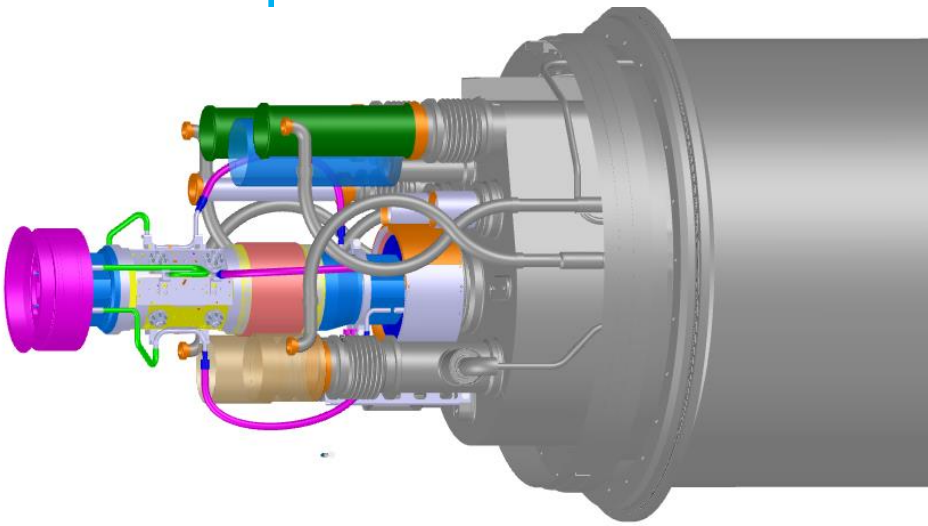


- ElQA test before sleeves welding

Intermediate ElQA tests may occur during the splicing work period, in order to confirm the electrical integrity of the assembly

Activity: Q1 to D1connection

- Sleeves welding (lip welding)
  - QC: Visual inspection
- Thermal shield lines welding (butt welding)
  - QC: Radiographies and visual inspection

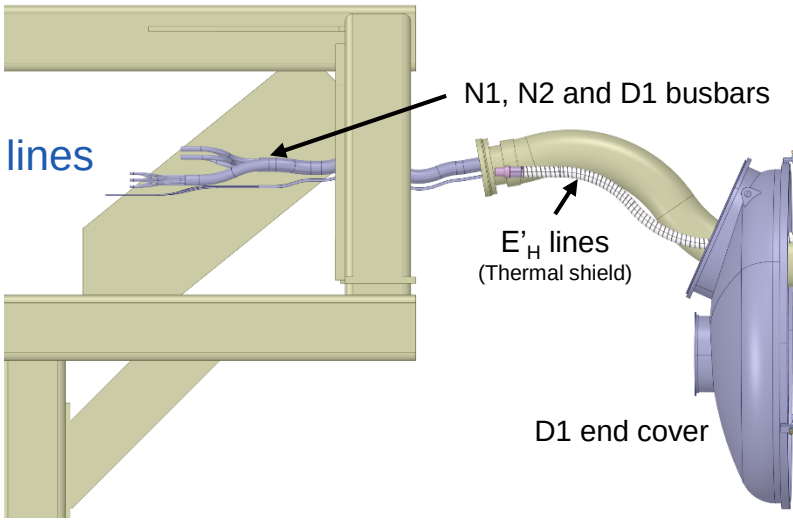


- Ready for local leak tests

Activity : DCM installation and connection

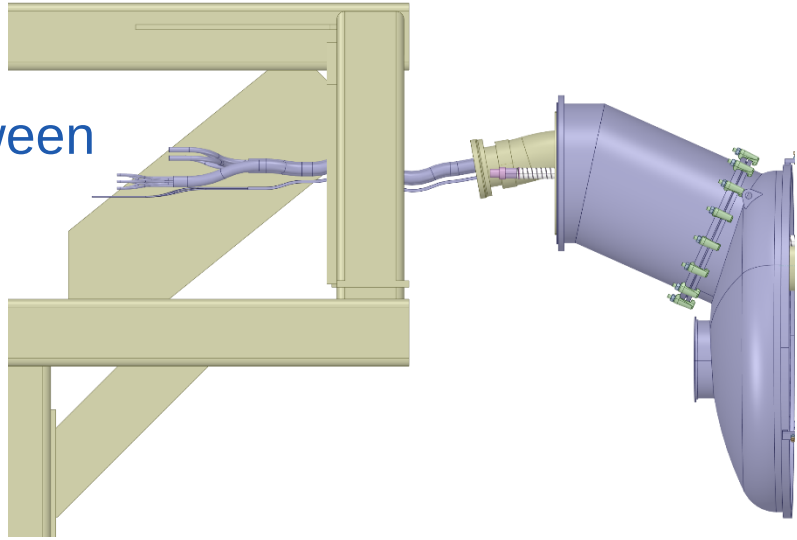
- Installation of the DCM frame

  if not done prior N lines pulling as a support of N lines



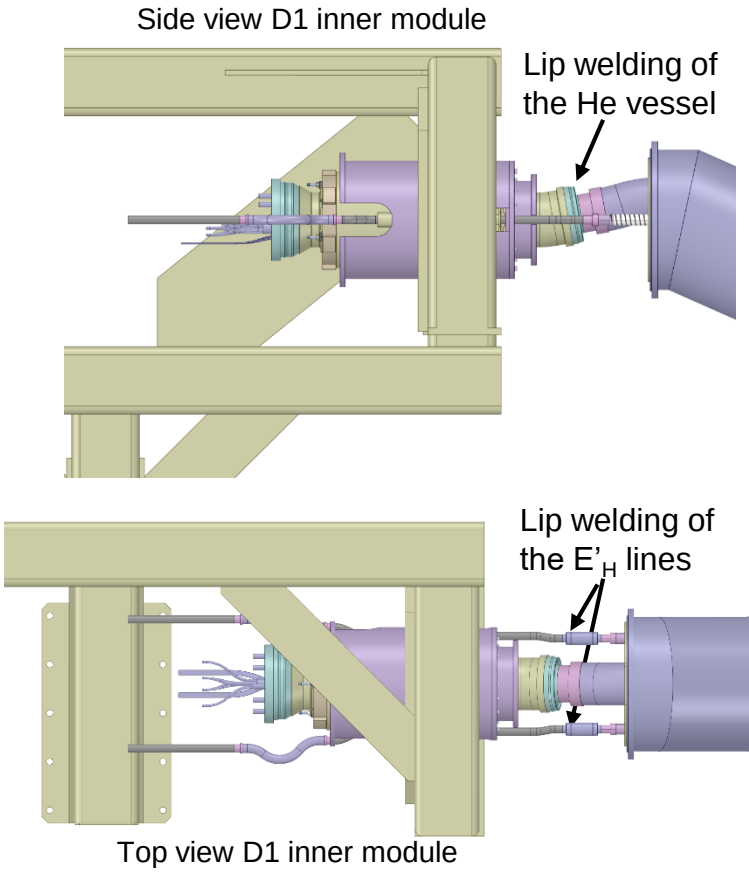
- Installation of the elbowed vessel between DCM and D1

  With thermal shield, MLI, outer shell… (No welding)



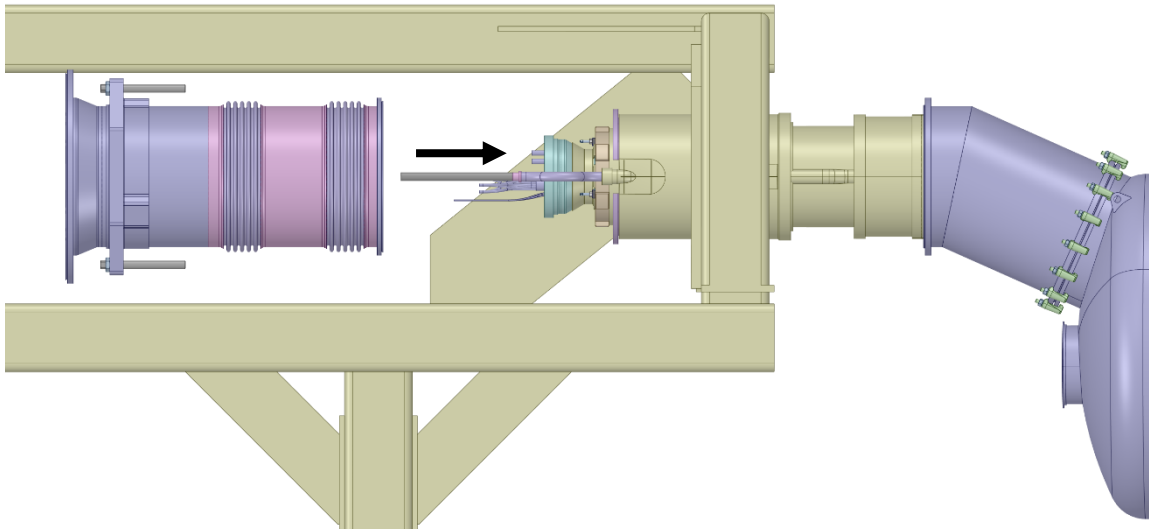
Activity : DCM installation and connection

- Installation of the inner part of the D1 module
  - Positioning of the module
    - Tooling and procedure to determine
  - Lip welding of the He vessel
    - Installation leak test (He bottle)
  - Lip welding of the E'_H lines
    - Installation leak test (He bottle)
  - QC holding point

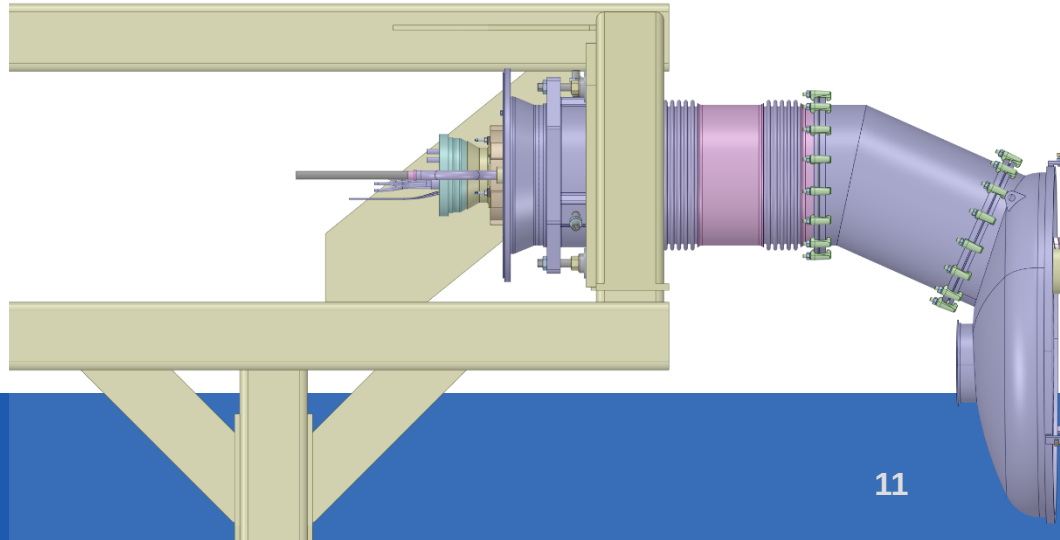


Activity : DCM installation and connection

- Insertion of the vacuum vessel of D1 module
  - Thermal shield,
  - MLI…

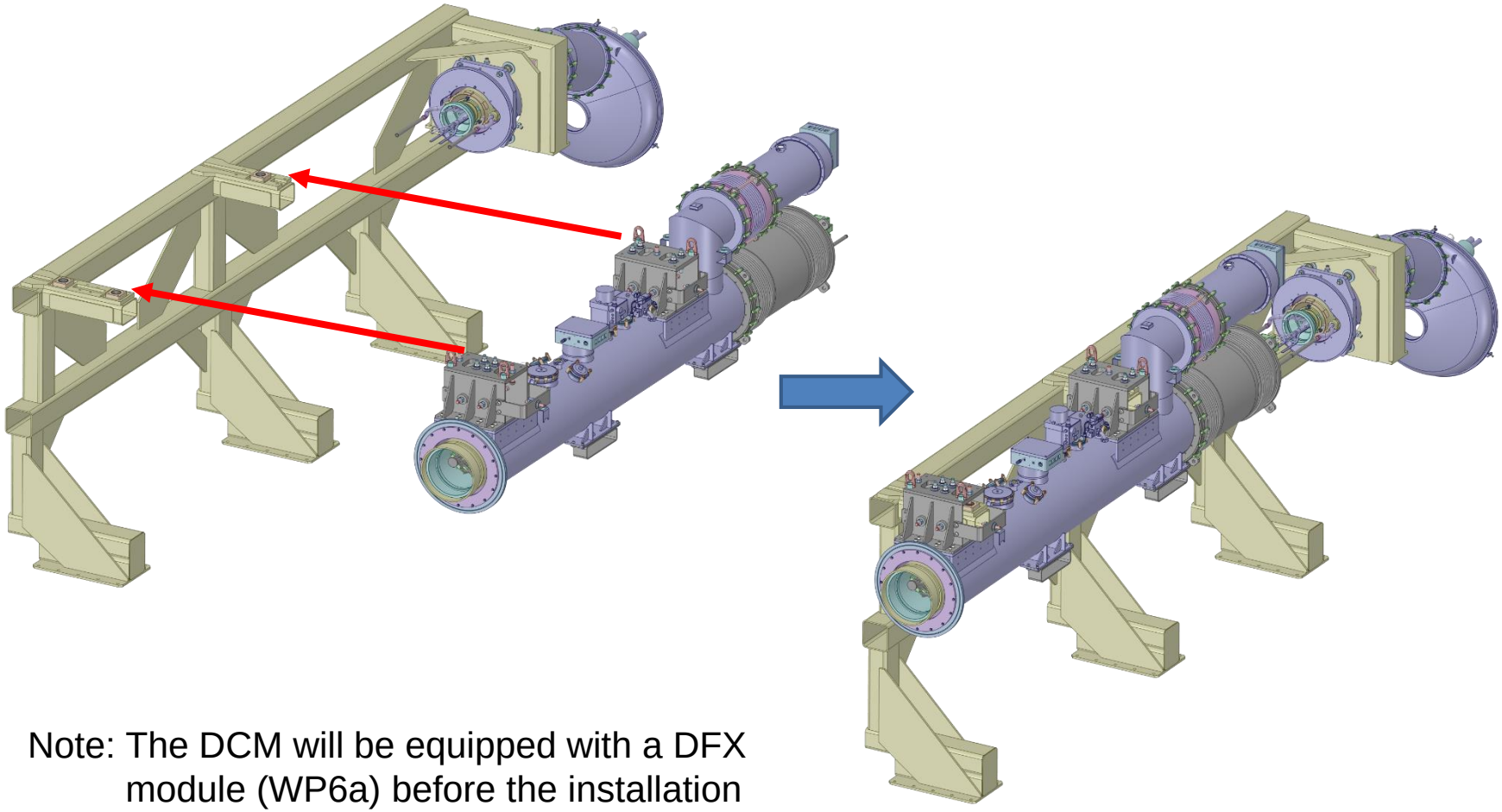


  - Correct positioning thanks to setting screws (criteria to determine)



Activity : DCM installation and connection

- DCM installation and alignment

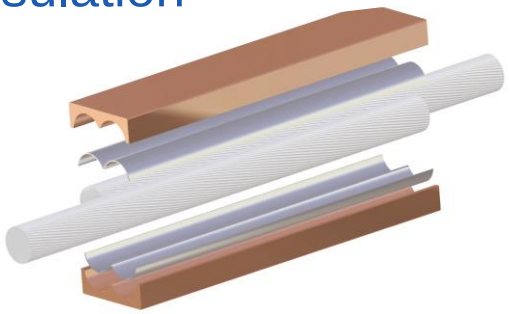


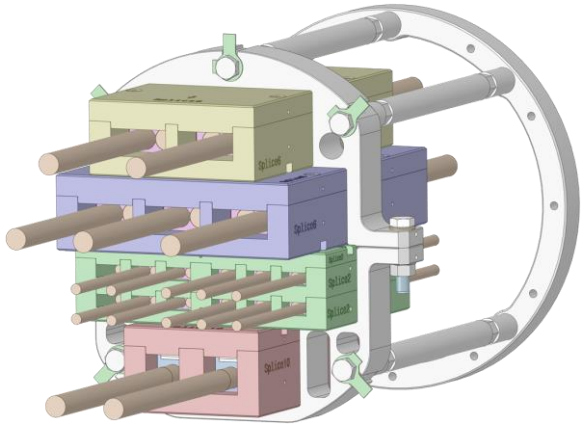
Note: The DCM will be equipped with a DFX module (WP6a) before the installation

Activity : DCM installation and connection

On each side of the DCM (D1-DCM & DCM-DFX interconnection)

- Splices connection (NbTi - NbTi) and splices insulation
  - 12 * 2kA cable splices → QC
  - 5 * 18kA cable splices → QC
  - 2 * 13-18 kA cable splices → QC
- Splices insulation → QC
- Insulation boxes installation → QC
- Installation of the fixe point → QC
- Instrumentation connection
  - On DCM-DFX interconnection only
  - Action WP6a
- ElQA test before sleeves welding

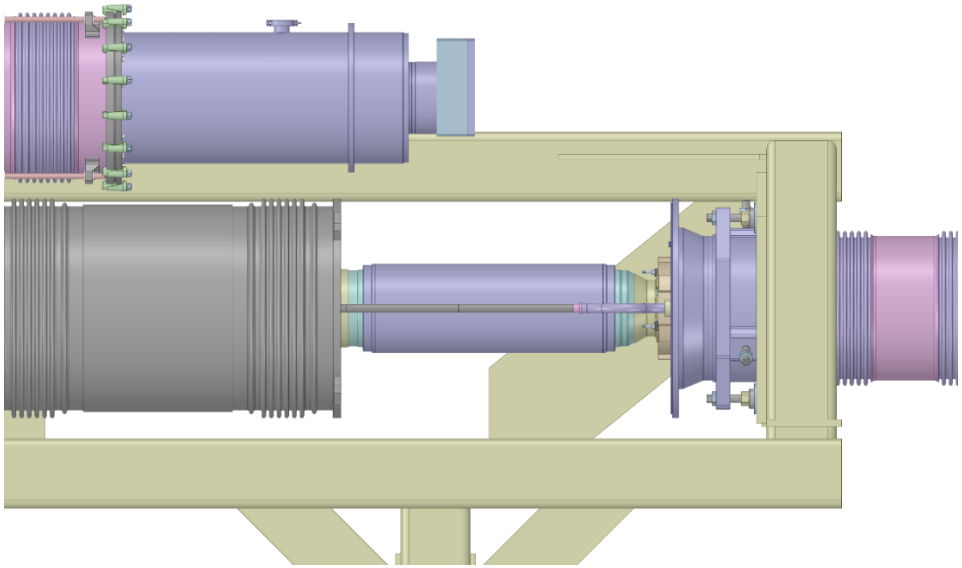




Preliminary concept of splices stack

Activity : DCM installation and connection

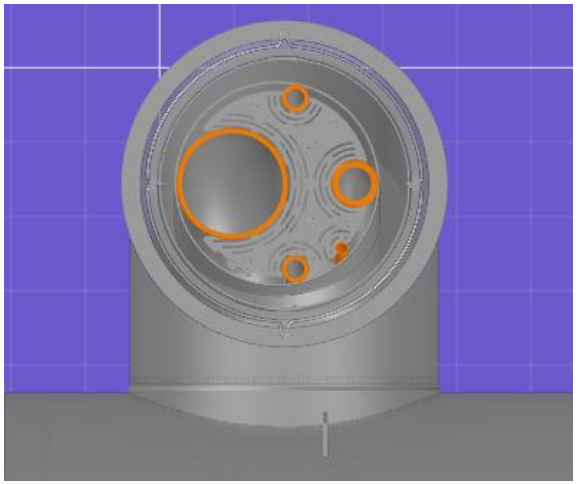
- Sleeve and E'_H lines welding
  - Lip weldings of N lines sleeve
  - Butt weldings of E'_H lines on D1-DCM interconnection only
    - radiographies



- Ready for local leak tests

Activity : Jumpers connection

- 3 Jumpers to weld
- Cryo-lines welding (lip & butt welding)
  - QC: Radiographies and visual inspection



- Ready for local leak tests

Local leak tests

Activity: Q1 to D1connection

Ready for local leak tests

Activity : DCM installation and connection

Ready for local leak tests

Activity : Jumpers connection

Ready for local leak tests

Pumping of the gas present in cold masses.

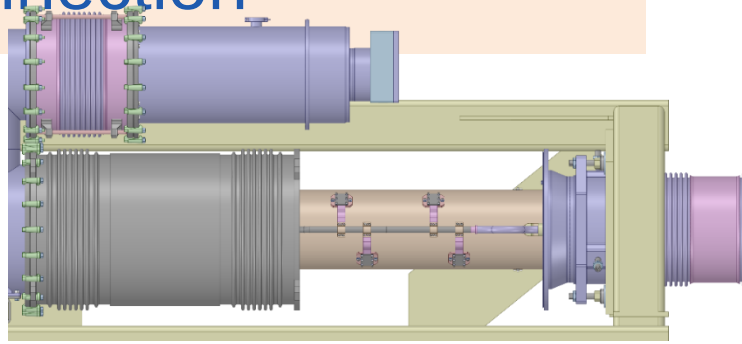
Injection of He gas from the SQXL to perform the local leak tests (TE-VSC) of all sleeves welded.

Activity: Q1 to D1connection

- QC : check before closure
- Thermal shield, MLI installation and W closure

Activity : DCM installation and connection

- QC : check before closure
- Thermal shield (active cooling)
- MLI installation and W closure



Activity : Jumpers connection

- QC : check before closure
- Thermal shield, MLI installation and W closure

Ready for global leak tests

Planning and technical resources

Technical resources and duration for each activity.

Few activites will be done in parallel if the resources are sufficient.

If external **QC** takes more than ½ day in the week, **extra time must be added.**

Learning time is reasonably considered in the given duration, but **time for non-conformity repair must be added !**

- N lines pulling
  - 2 field coordinators, 3 technicians (2 staff, 1FSU)
  - Duration : 1 week

- D1 module and DCM installation (without splices connection)
  - 2 technicians (1staff, 1 FSU)
  - Duration : 2 weeks

Planning and resources

- Splices connection and fixe points installation
  - 2 teams of 2 for splices soldering (2 staff, 2 FSU)
  - 1 person for fixe point and eccobond injection (1 FSU)
  - Duration : 3 weeks for D1-Q1 section
  - Duration : 2 weeks for DCM interconnections

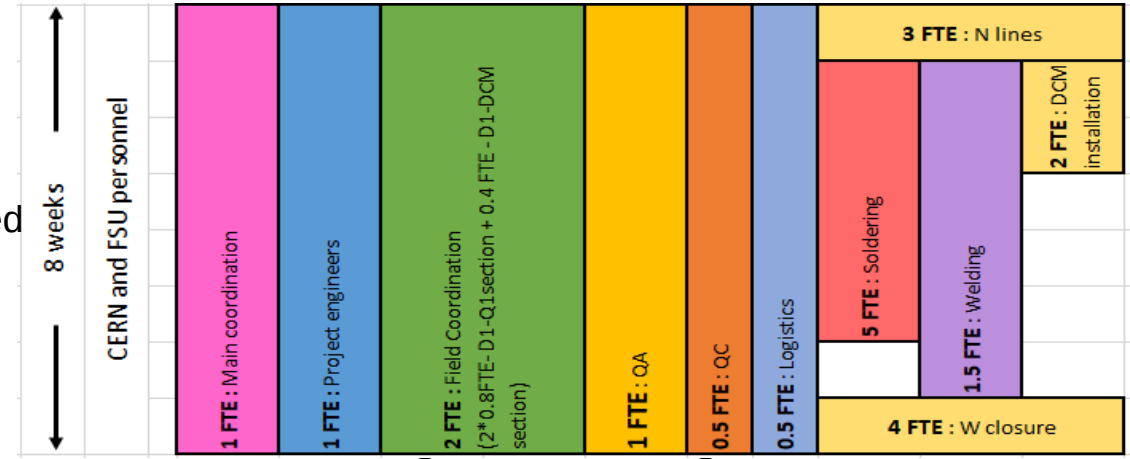
- Welding : Jumpers and cryo-lines
  - 2 experienced welders from MSC
  - Duration : 6 weeks (75% time)

- Thermal shields and W closure
  - 4 technicians (2 staff, 2 FSU)
  - Duration : 1 week

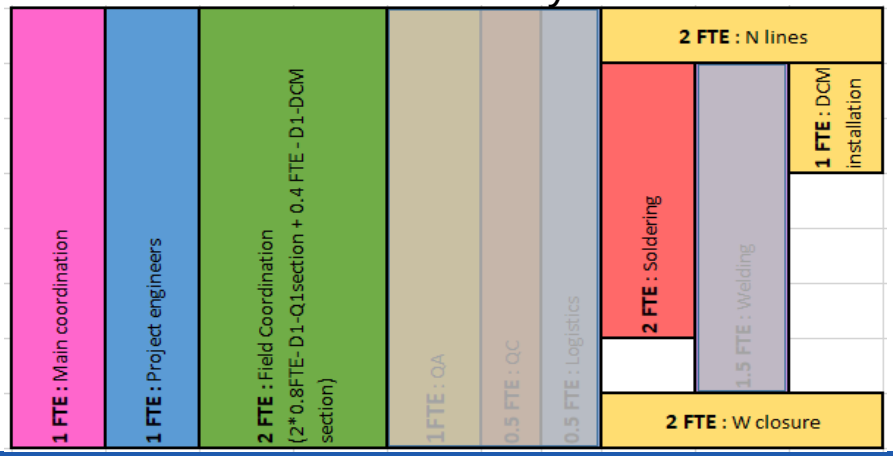
Summary on resources

MSC activities = 8 weeks, but the interconnection work will take longer (Local leak test, FRAS, ….)

FTE are considered over the 8 weeks period

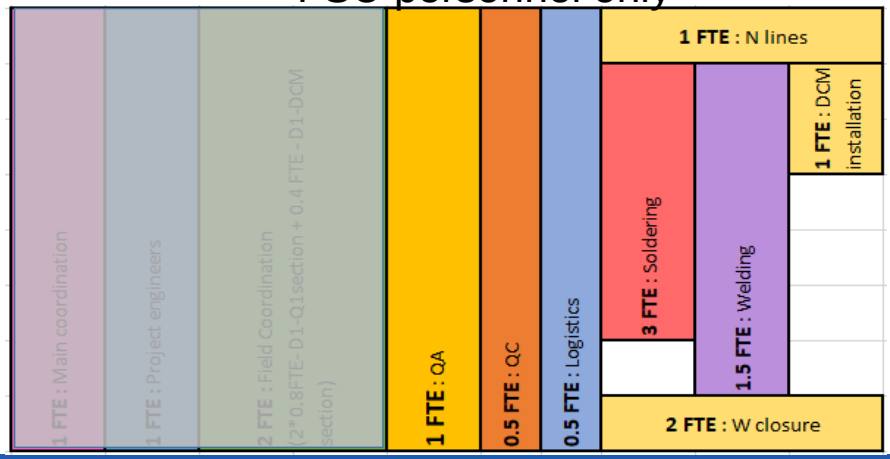


CERN staff only



6 FTE

FSU personnel only



5.6 FTE


CERN

Top of the iceberg

The interconnection work is only the top of the iceberg. A lot of work, drawings and documentation need to be prepared.

- Test on simple mock ups (line N pulling, Splice soldering, …)
  - Define the tooling
  - Prepare the procedures
  - …
- Validate the drawings
  - Global and detail views
  - Kit for interconnection
  - …
- Define the interface of WP3 with the other WPs ☑
  - Interface to the superconducting link (WP6a), defined in EDMS 2429304
  - Interface to the cryogenics (WP9), defined in EDMS 2728042
  - Interface to protection (WP7), defined in EDMS 2369405
  - Interface to FRAS (WP15), defined in EDMS XXXX
  - Local/global leak test?
  - …
- Define the QC procedures
  - Criteria to define and procedures