DCM: Integration and Transport

TE-MSC Internal review of the D1 DFX connection module 15/04/2021

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INTEGRATION 3D MODELS: ST references

**Full LSS Skeleton (from Q1 till Q7) v.1.5**

- **IP5 Right:** ST1212591_01 - LSS5R Skeleton_HL-LHC 1507 LS3
- **IP5 Left:** ST1212605_01 - LSS5L Skeleton_HL-LHC 1507 LS3
- **IP1 Right:** ST1212928_01 - LSS1R Skeleton_HL-LHC 1107 LS3
- **IP1 Left:** ST1212939_01 - LSS1L Skeleton_HL-LHC 1107 LS3

**Full LSS HL-LHC machine (from Q1 till Q7) v.1.5**

- **IP5 Right:** ST0967508_01 - C1->C7_R5_1507 BASELINE STUDY LS3
- **IP5 Left:** ST0969291_01 - C1->C7_L5 BASELINE STUDY LS3
- **IP1 Right:** ST1214770_01 - C1->C7_R1_1107 BASELINE STUDY LS3
- **IP1 Left:** ST1215038_01 - C1->C7_L1_1107 BASELINE STUDY LS3

**Simplified models provided by J. Dequaire:**

- ✓ DCM assembly P5R P1R: ST1158927_04
- ✓ DCM assembly P5L P1L: ST1158927_03

**Full LSS (from Q1 till Q7): tunnel + services + new machine v.1.5**

- Used for general integration purposes:
  - HL-LHC machine layout studies
  - Full Remote Alignment System design
  - Cryoline design (new QXL + matching section study for QRL)

**Frozen as “BASELINE v.1.5”**
DCM location at the LHC tunnels: IP1 and IP5

- Different shape and dimension of LHC tunnels:
  - IP1: Ø=4400mm, IP5: Ø=3800mm
- Different Slope and Tilt
- Different beam height:
  - IP1: h=1100mm, IP5: h=950mm
- Different QXL elevation – vertical distance between beam axis and QXL axis:
  - IP1: h=350mm, IP5: h=530mm
DCM location at the LHC tunnels: IP5 R

- **Dimension of R562:** IP5: Ø=3800mm
- **Definition and routing of HL-LHC services is under study**
- **Access to cryo-valves**
- **DCM support adapted to vacuum layout**
- **Manhole cover**
- **Re-worked vacuum layout Reservation Ø400mm**
- **Beam height:** IP5: h=950mm
- **Tilt:** -0.79%
- **Slope:** -1.24%

**Detailed study at Point 5 right, since the integration at this region is more advanced**
DCM location at the LHC tunnels: IP5 L

Definition and routing of HL-LHC services is under study.

Dimension of R541: Ø=3800mm

Beam height: IP5: h=950mm

Space reserved for DCM maintenance and manipulation included in the 3D model provided. Once new configuration of HL-LHC services is defined, it should be re-verified, to avoid interferences.
Definition and routing of HL-LHC services is under study.

Dimension of RI171:
IP1: Ø=4400mm

There is more available space in for services IP1 than in IP5.

Tilt 0.66%
Slope 1.24%

Beam height P1: h=1100mm

This difference should be taken into consideration for the final design at IP1.

The height of the supporting frame for IP1 should be adapted.
DCM location at the LHC tunnels: IP1L

Dimension of RI132:
IP1: Ø=4400mm

This difference should be taken into consideration for the final design at IP1

Beam height P1: h=1100mm

Definition and routing of HL-LHC services is under study

There is more available space in for services IP1 than in IP5

The height of the supporting frame for IP1 should be adapted
Fixation to the ground study

Floor study - Research for manhole covers around DCM region.

It seems that only at 5R there is a manhole cover that falls at the level of DCM. In the existing LHC configuration this area falls right after the x6 warm magnets (D1), as you can check on the pictures retrieved from GIS portal.

For 5L, 1R, 1L there is nothing remarkable on the floor.
Advances on the QXL. Installation tolerances.

Installation tolerance volumes has been created in order to detect, anticipate and solve potential conflicts between systems. Presented in WP15 meeting (26/03/2021): https://indico.cern.ch/event/1020935/

No problem encountered with DCM supporting frame so far.

Tolerance considered for DCM: 15mm
No problems detected.

However, the remaining space between the DCM supporting structure (yellow) and the new QXL is quite tight (see cross sections)
Transport in the tunnel and installation will be carried out using a lateral forklift. The use will be shared with the DFM (WP6A)
Transport and installation

With the integration of the slots for the lifting forks and the planned purchase of the lateral forklift, the installation approach is clear. Final access shaft for transport still to be determined. Final verification of lifting points with overhead cranes still to be carried out. The centre of gravity of the assembly will be relatively high and this can be tricky.
Conclusion

- No major issues detected from integration point of view thanks to the fact that the present design has been iteratively discussed between WP3 and WP15.
- Supporting system and accessibility on the back (for cryogenic equipment) are key. The supporting system design already integrates the requirements for the access to the beam line and floor fixations.
- Differences between P1 and P5 (beam height) shall be accounted for.
- We point out that services routing is not completed. The target is to keep them out of interference range. Nevertheless, we cannot exclude the need to review the maintenance volume once that this activity will be completed.
- Transport and installation strategy are well clear. Minor points to be set when nearer to installation.
ADDITIONAL VIEWS
Fixation to the ground study

Floor study - Research for manhole covers around DCM region.

It seems that **only in 5R there is one manhole cover** that falls at the level of DCM.

For 5L, 1R, 1L there is nothing remarkable on the floor.

Adequate distance from the trench edge. Verified with SMB.
Integration overview
Integration overview