



# Preparation of the ECR regarding the modification of the HL-LHC base line for a-C coating

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# Present base line for a-C coating

- During **Long Shutdown 2**:
  - *In-situ* coating of
    - D1Q3Q2Q1L2 + D1Q3Q2Q1R2
    - D1Q3Q2Q1L8 + D1Q3Q2Q1R8
- **Between** LS2 and LS3:
  - *Ex-situ* coating of
    - D2L1 + D1CPQ3Q2Q1L1 + D1CPQ3Q2Q1R1 + D2R1
    - D2L5 + D1CPQ3Q2Q1L5 + D1CPQ3Q2Q1R5 + D2R5

# Proposed new base line for a-C coating

- During **Long Shutdown 2**:
  - *In-situ* coating of
    - Q6R2 + Q5R2
    - Q6L8 + Q5L8
- **Between** LS2 and LS3:
  - *Ex-situ* coating of
    - D2L1 + D1CPQ3Q2Q1L1 + D1CPQ3Q2Q1R1 + D2R1
    - D2L5 + D1CPQ3Q2Q1L5 + D1CPQ3Q2Q1R5 + D2R5
    - Dipole, quadrupole and CP's electron shields located behind pumping slots
    - Interconnections of Triplets region in LSS1 & 5 (5 x 4)
- During **Long Shutdown 3**:
  - *In-situ* coating of
    - D1Q3Q2Q1L2 + D1Q3Q2Q1R2 + D2Q4R2
    - Q4D2L8 + D1Q3Q2Q1L8 + D1Q3Q2Q1R8
  - *Ex-situ* coating of
    - Q5L1 + Q4L1 + Q4R1 + Q5R1
    - Q5L5 + Q4L5 + Q4R5 + Q5R5



***Thank you for your attention***





## *Spares slides*



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## Proposal: C coating in the stand alone magnets

The **heat load in standalone** magnets is **higher than expected** (up to 100 W per magnet). It is foreseen to increase for HL-LHC. [14]

The heat load limitation could be removed by changing the seat of the cryo control valves. However, the **higher load would limit the available refrigeration power for the arcs: 600 W** for Q4D2+Q5+Q6, i.e. **20% of the 3 kW available** for electron clouds in HL-LHC.[15]

Additional margin in the refrigeration power for the arcs would be achieved by **coating all beam screens of the standalone magnets**. This is **particularly true for R2 and L8** that are cooled by ex-LEP's refrigerators.

- ⇒ It would be **beneficial to coat a selected number of Q6 and Q5's beam screens during LS2** in combination **with additional instrumentation**. This would allow to determine the ecloud contribution to the heat load.
- ⇒ The **treatment of the Q5 standalone is much less demanding; the one of Q6** might be more tricky in terms of access to the beam pipe due to the proximity of the DFBA. No realignment needed. Manpower requirements (TE-MS) to install at least 3 additional thermometers per magnet need to be evaluated.



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## Conclusions

We suggest that:

- **In LS2**, carbon coating would be implemented in (a selected number of) Q6-Q5 standalone magnets, instrumented as required.

Advantage:

→ Confirm heat load reduction.

- **In LS3**, if positive results are achieved with treated beam screens, carbon coating or laser treatment would be applied to all LSS cold magnets.

Advantages:

→ No intervention in the cryogenic infrastructure in IR2 and IR8.

→ No e-cloud instabilities from IR1 and IR5 in HL-LHC.

→ Reserve of refrigeration power available for the beam screens of the arcs.



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