SPS dipole prototype coatings

Scope

Design and built up

The test runs

Surface treatment

Coating of the dipoles

Summary of good & bad

Conclusions

SPS-U meeting 2009-03-24

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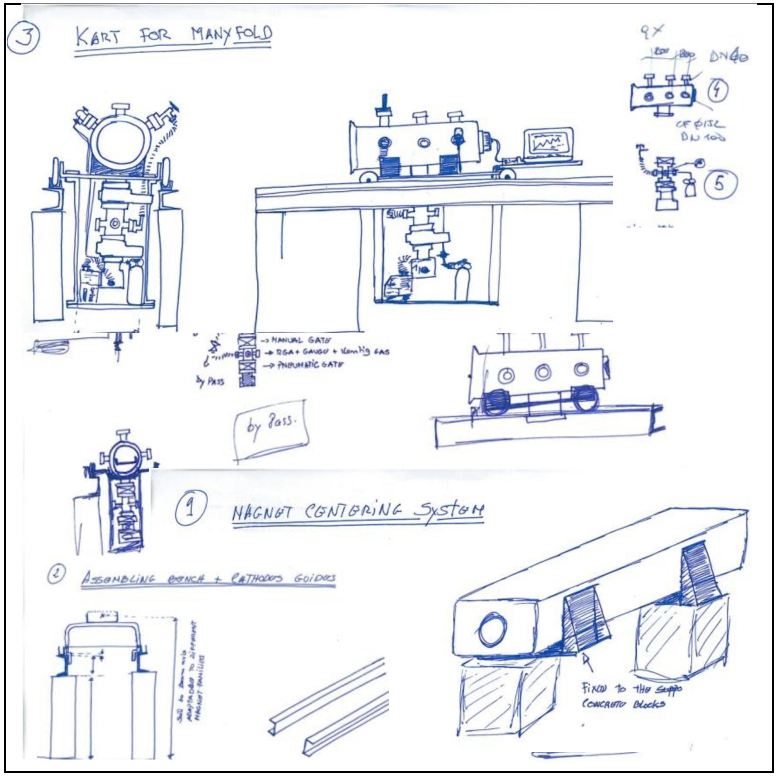

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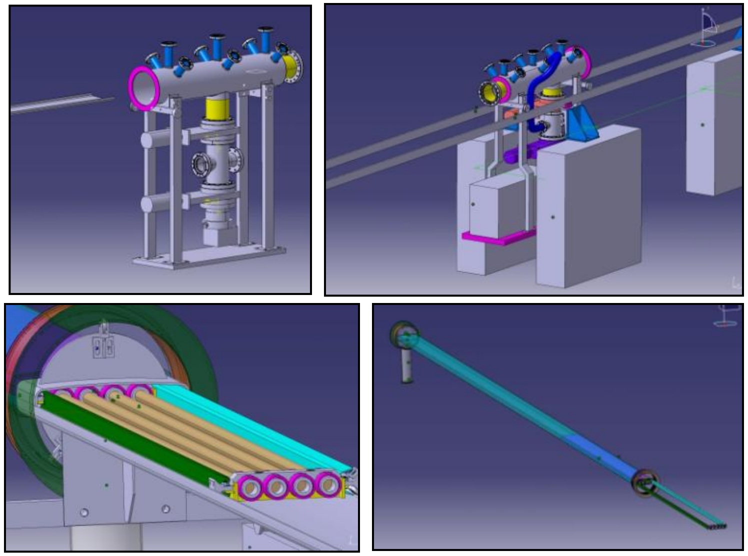

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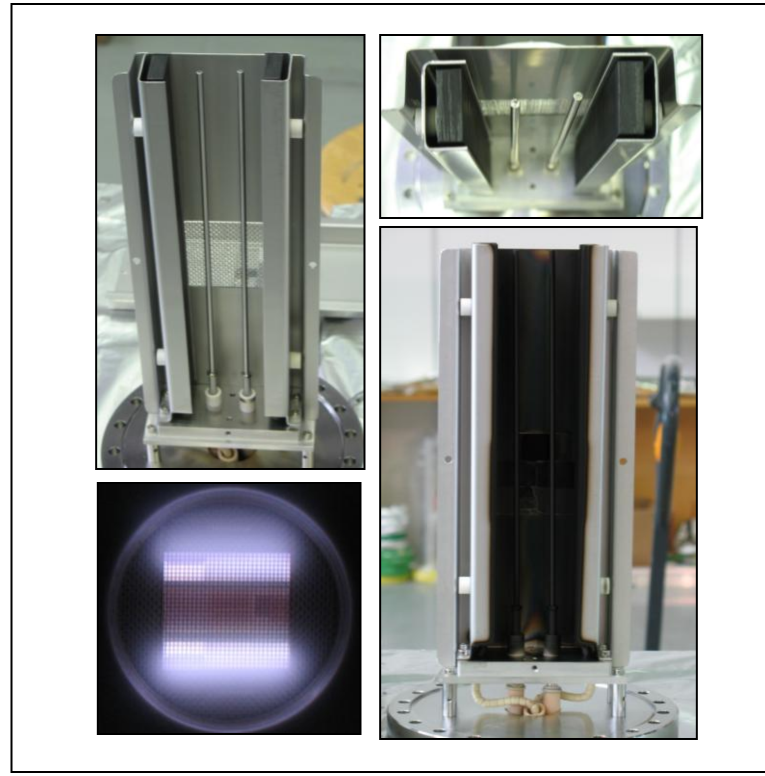

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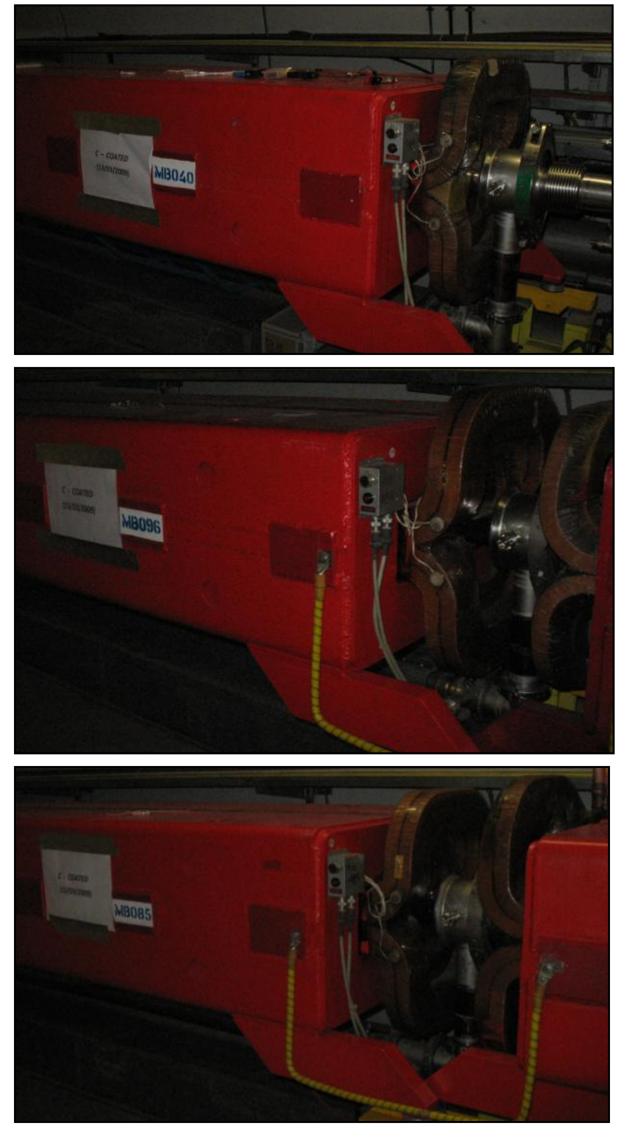
- March 2009: installation of the three dipoles

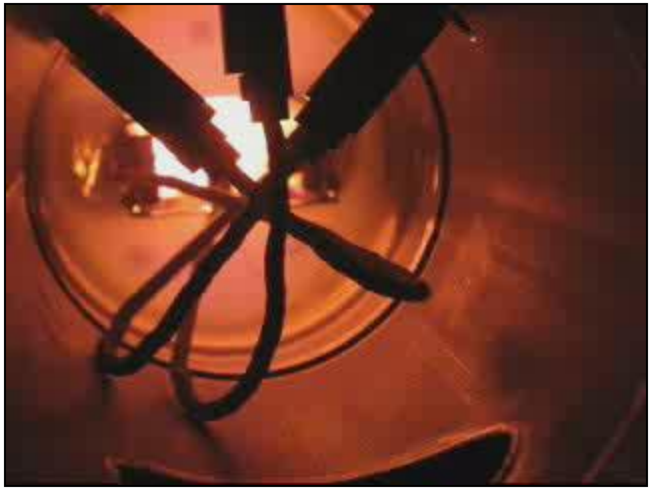


SPS dipole prototype coatings

4 test runs in liner

Main difficulties:

- Plasma unstable => run at high pressure (3.5×10^{-1} mbar)
  non uniform magnetic field at extremities



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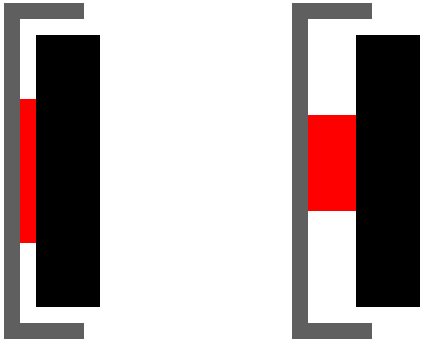
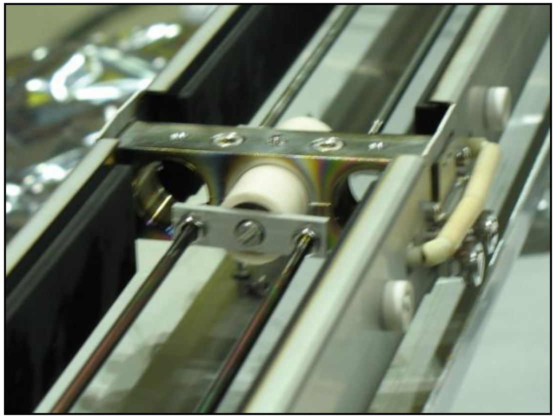
Highly non uniform transversal thickness profile:

~10x thicker near the cathodes than at the center





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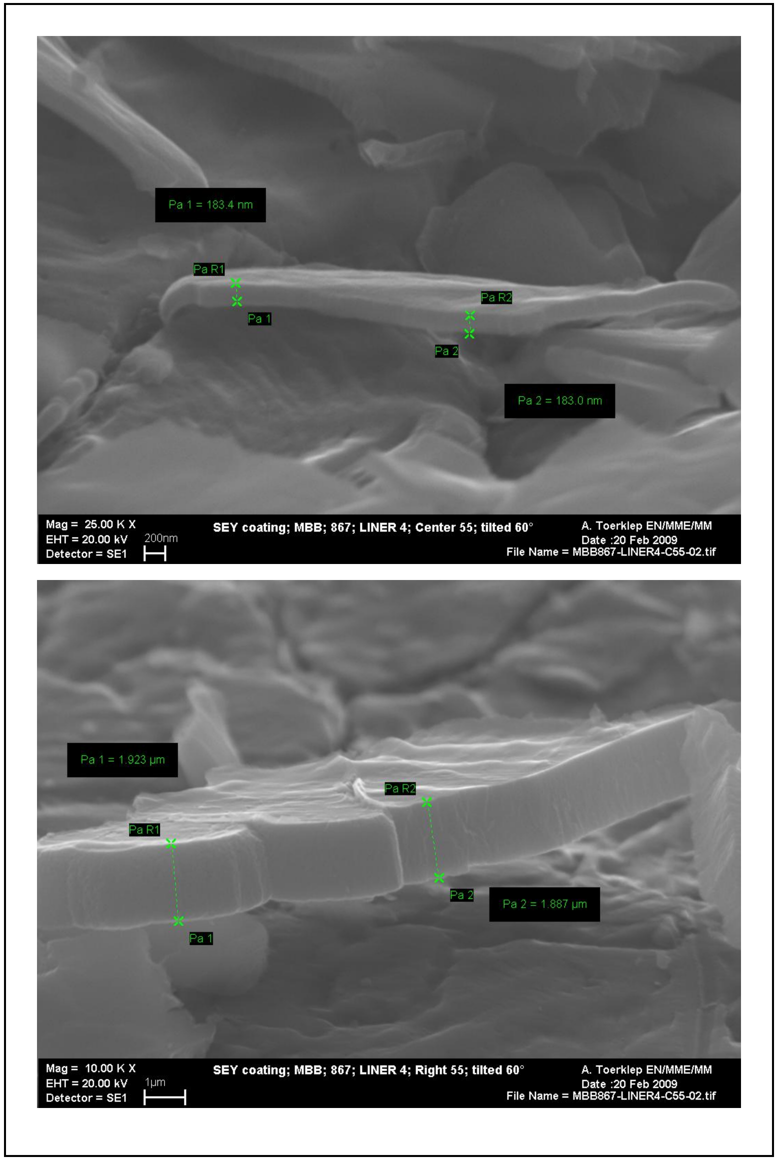

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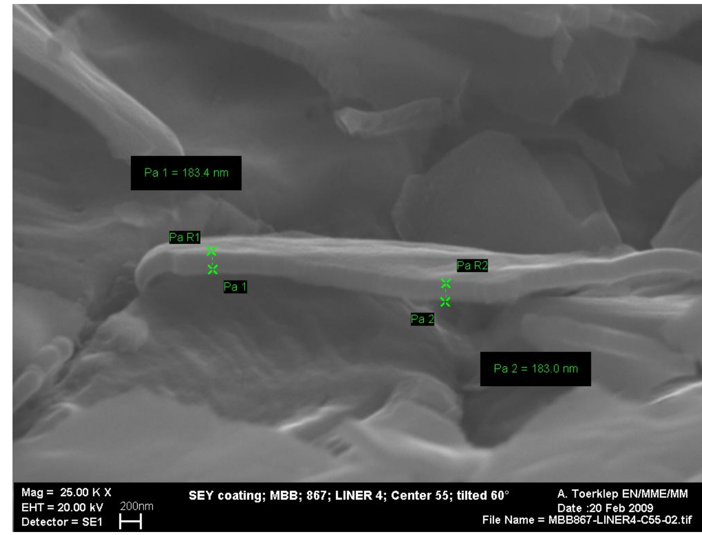
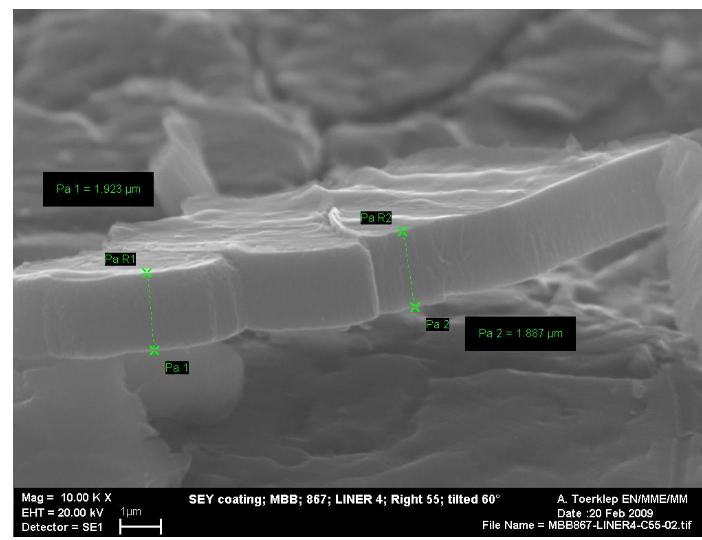
- During the 4 runs several modifications were introduced. *Anodes configuration, isolation, geometry at extremities, thermocouples, etc.*

The possible modifications regarding the time available…

- After the 4th run no more time for tests => COAT DIPOLES





SPS dipole prototype coatings

Coating of the three dipoles

Surface treatment:

- Control before surface treatment: hydrocarbons and silicon contamination.
- Procedure:
  1. Brush with acetone
  2. Rinse with demineralized water
  3. “lessive” Galvex (for Silicon contaminations)
  4. “lessive” P3 Almeco (for hydrocarbons)
  5. Rinse with demineralized water
  6. Dry by air flow
- Results: ok for silicon; but remain traces of hydrocarbons

> *“Les résultats ne sont pas brillant, forte présence de particules métalliques et de produit hydrocarbonés (sans surprise). Par contre, présence de produits silicones...”*

Report N° VSC–CSA : X-02/01.09 by **B. Teissandier**

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- Results: ok for silicon; but remain traces of hydrocarbons
- The mysterious “white spots” are not removed by the surface treatment.

“Les résultats ne sont pas brillant, forte présence de particules métalliques et de produit hydrocarbonés (sans surprise). Par contre, présence de produits silicones...”

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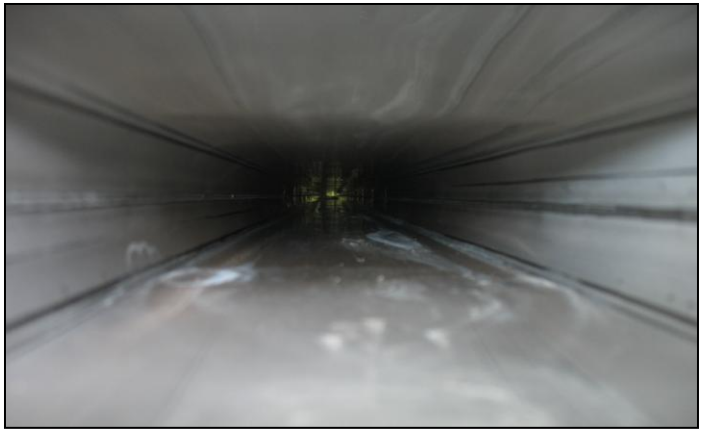
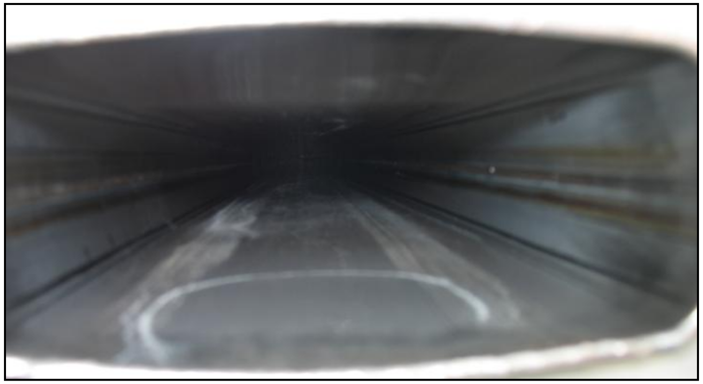




SPS dipole prototype coatings

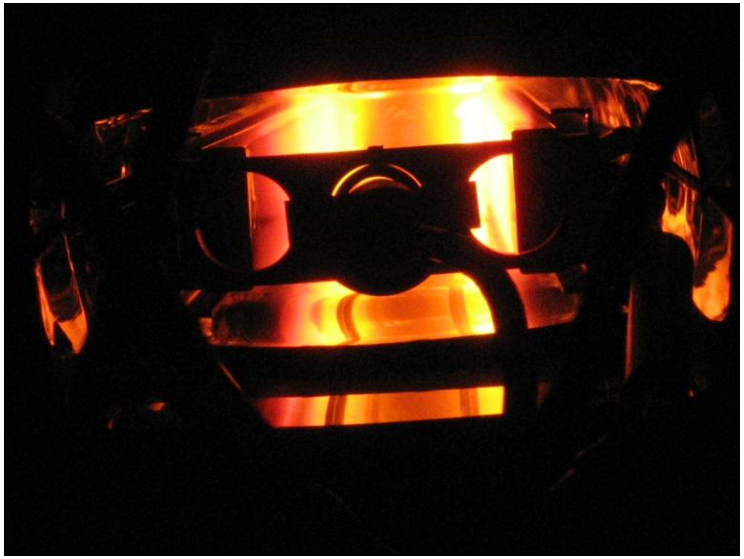
Coating of the three dipoles

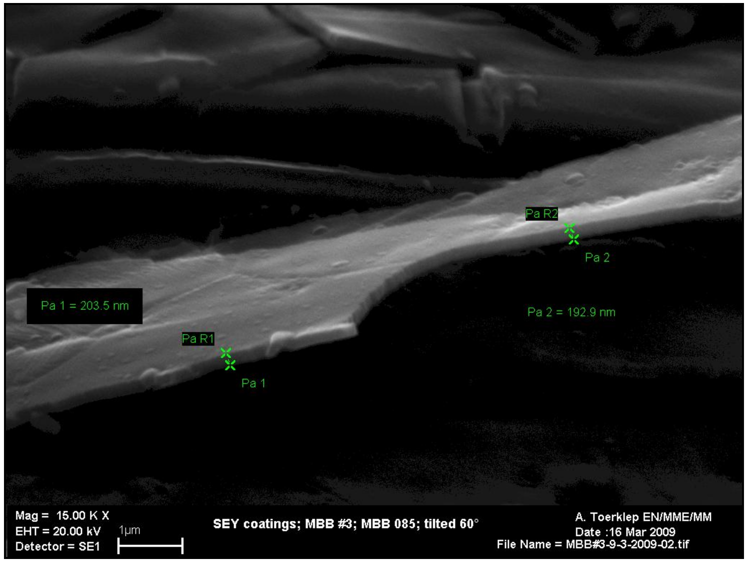
Coating:

- Parameters:

  Pressure between 3.0×10^{-1} and 3.9×10^{-1} mbar
  Power ~ 2kW
  Voltage ~ 900 V
  Temperature on the side of the chamber ~ 120 ^{o}C

- Thickness: the same non uniformity of the test runs: ~200 nm at the center, ~1500 nm near the cathodes.
- Endoscopy after coating only possible in MB096: no evidence of peel-off .
- Storage after coating: 1.2 bar of N_2
- SEY after coating = 1.0
- SEY just before pump down in the tunnel = 1.0
- **During installation in the tunnel *PEEL-OFF* observed in MB085! (only ~ 1 cm^2… but always scaring!)**





SPS dipole prototype coatings

Good&Bad: *the coating itself*

BAD

- Too non uniform thickness
- Not all the length is coated (95%)

GOOD

- SEY around 1
- Ageing (… so far…)

Good&Bad: *the coating process*

BAD

- Plasma quite unstable! (not reliable)
- Isolation system need to be changed every run
- Thermal deformation of the anodes
- Deposition time too long (34 hours)
- Wheels sliding, not rolling! (dusty)
- Temperature monitoring not allows displacement of the electrodes

GOOD

- Fast mounting/dismounting (if not necessary to change isolation)
- Easy to control the coating pressure
- Potential for a large scale production.

But the electrodes have to be modified

SPS dipole prototype coatings

Modifications

•drive the plasma independently at the extremities => ***increase stability, decrease pressure, improve thickness profile and adhesion, decrease coating time.***

•Shield the bottom and top of the cathodes => ***increase stability, improve thickness profile and adhesion.***

•Use ceramic screws for the cathodes supports => ***faster mounting/ dismounting.***

•Introduce stainless steel plate between the back of the cathode and the ceramic isolation => ***avoid current leaks due to graphite "dust", improve reliability.***

•Modify the anodes system to avoid thermal deformation => ***increase stability, improve thickness profile and adhesion.***

•Decrease distance between cathodes? (40mm) => ***improve thickness profile and adhesion, decrease coating time, decrease outgassing of the chamber, allow higher power?***

•Change the temperature monitoring system => ***compatible with the displacement of the electrodes.***

SPS dipole prototype coatings

Conclusions

•The system is not so bad… but it is not good enough!... Yet.

•Good SEY and ageing but the peel-off observed with the dipoles already in the tunnel is scaring.

•Modifications towards ***thickness uniformity***, ***stability of the discharge*** and ***reliability of the electrodes isolation***

•Re-think surface treatment

•Start studying the piling-up of coating systems?

•Prepare liners to be coated inside the dipoles and tested in the SPS?

First test run on the 10th February, dipoles installed the 10th March.

It was intense, stressing, but very pleasant.