TE-VSC SUMMARY

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A biased opinion

An impressive work has been performed in TE-VSC for the FCC study.

Firstly, for the FCC-hh in the frame of EU Horizon 2020 where we led a European collaboration.

Then, for the FCC-ee for which we have demonstrated the implementation of innovative technologies, applied and developed simulation tools, prepared cost estimations, and initiated prototyping.

We need now to move towards the final feasibility phase, while thinking to industrialisation.

Concern (1) : SRF specs are within reach, but not yet achieved

As Guillaume has explained, in the last years, we had an **important advancement** with the performance of Nb coatings.

However, the lack of RF tests and availability of 400 MHz substrates **slowed down the development.**

Today, **we do not have the experimental proof** that we can attain the specs for the two-cell cavities, even if we are optimistic for the next years.

Concern (2) : industrialisation of developed technology

As Roberto wrote: '**Standardization and easy-to-transfer to industry** design and technology must be implemented.'

However, most of the technologies that we have developed for 10 years are **not 'standard',** at least for accelerators.

SMA, additive manufacturing, friction stir welding, embedded bakeout elements, electropolishing of relatively large cavities **need an important effort for industrialisation**.

For example, as Cedric pointed out, within the present design, we need 23000 ((80000m/28m) quadrupoles * 4 SMA/quadrupole/ligne * 2 lignes) small SMA rings and 29000 ((80000m/28m) halfcells * 5 SMA/halfcell/ligne * 2 lignes) oval SMA rings; however; today, we do not have consolidated industrial partners. We need to find/create them. **This implies an investment** to which we should contribute.

Concern (3): availability and readiness of the Industry for standard components

I suppose that the supply of the vacuum system follows that for magnets: **5 years**.
The industrial production of some standard components will be stressed and put in an unusual condition, with potential impact on lead time and on start of delivery.

I give you an example: sputter ion pumps.

In the present design and layout, we need 13000 SIP, i.e 2600 per year. The most important supplier should increase by 20% the present production rate, but also should accommodate other customers.

Another example: gate valves with special RF fingers → 400 units only for the main arcs, 80 per year and, today, only one supplier.

Another example: hydroformed bellows (80000m/28m) halfcells* 2 bellows/halfcell/ligne * 2 lignes → 11500 units only for the main arcs, 2300 per year.

The same applies to gauges, controllers, PLC, etc.

Concern (4): NEG coating large-scale production

Assuming the main rings are **NEG coated**, we have roughly 18000 chambers to coat. If the booster is also coated, this value will be roughly 25000.

This means **5000 chamber to be coated per year**. If we found 3 industrial partners working 250 days/year, we will have 33 chambers coated per week per industrial site, i.e. a full transport per week per production site, i.e. **three lorries to be unloaded per week**.

This production and logistic pace have **never been tested before**. Today there is only two companies, only one owner, that can coat vacuum chambers but at a rate that is not at all comparable.

Beside the production rate and logistic issues**, how and where do we ensure quality control?**

The same considerations apply to SRF cavities, notably to the Nb coating.

Concern (5): MDI & Booster

There are parts of the accelerator that have not been studied in detail. **MDI and the Booster** are the main examples. And **nothing has been done for the injection line**.

The TE-VSC group should lead the technological studies of these important parts of FCC-ee.

Concern (6): Radiation hardness

As shown by Grégory, in the tunnel there will be an **unprecedented level of radiation** that impose choices of materials and devices, with an important impact on cost (see cables).

The **study of the shielding and of its implementation is an essential task** that we accepted to coordinate with MSC and SY/STI. The efficiency of the shielding will define the rate of material/electronic failure rate during operation.

FCC

Thank you
for your attention.