CNGS Horns : Status

8 nov. 2003

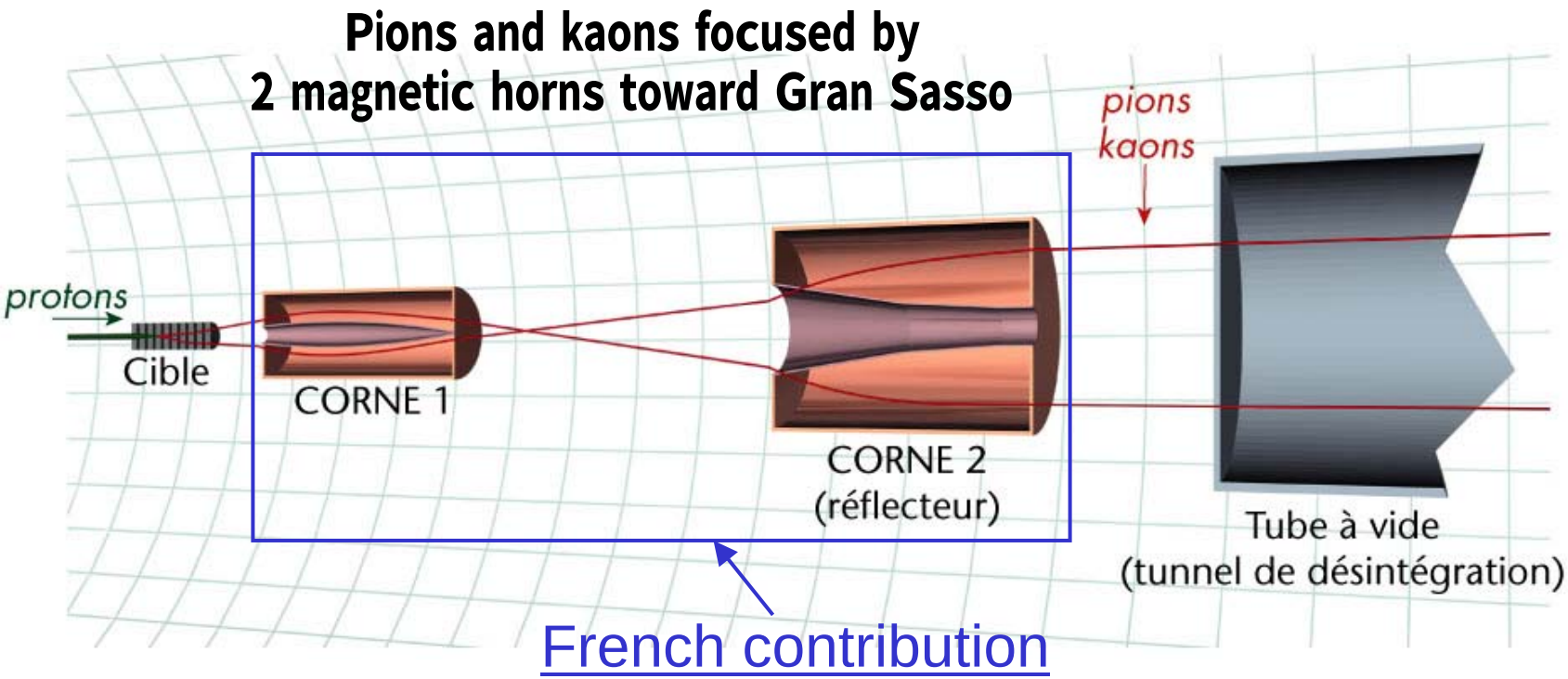
NBI 2003 – KEK, Japan
7-11 nov. 2003

CNGS Horns : Status

CONTENT

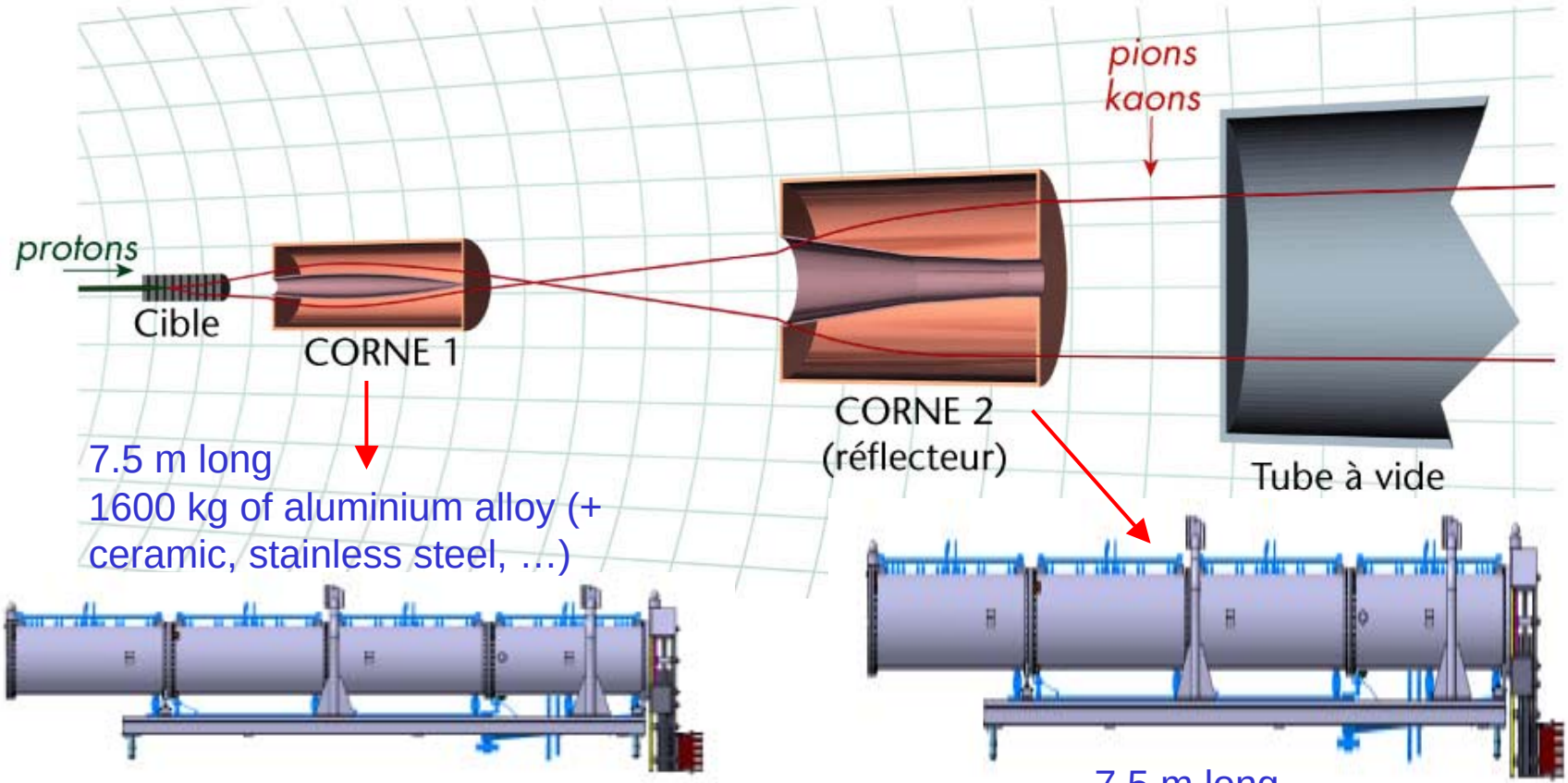
1. **Outline of the contribution**
2. **Design & studies**
3. **Manufacture & checkings**
4. **Mounting & adjustments**
5. **Summary**

1. **Outline of the contribution**



- 2 horns (included 1 spare horn)
- 1 reflector
- 2 cooling systems
- 2 strip lines w/ fast coupling system
- 2 sets of adjustable supports

2. Design & studies



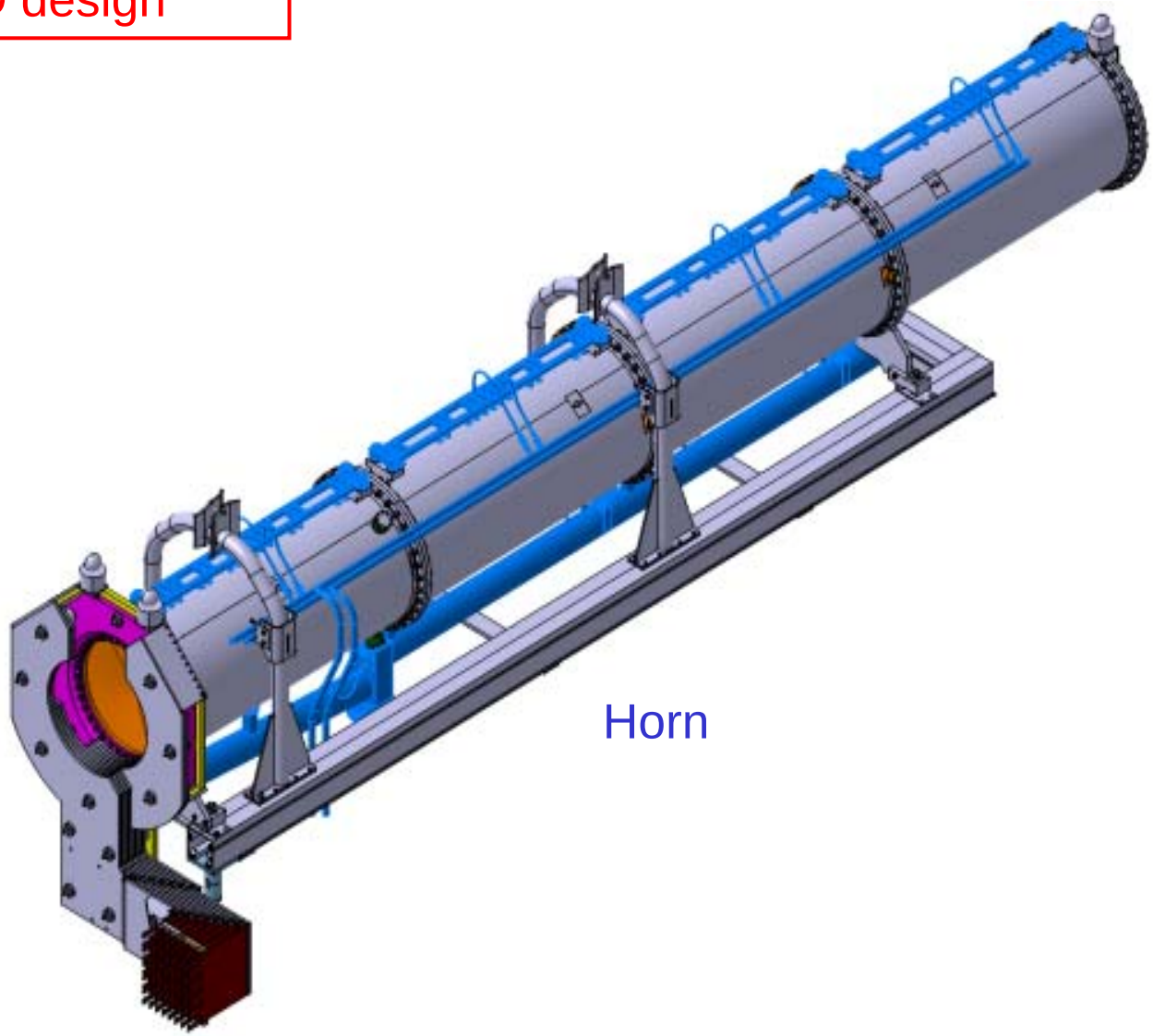
7.5 m long
1600 kg of aluminium alloy (+ ceramic, stainless steel, …)

7.5 m long
2200 kg

Double pulses within 50 ms
Pulse duration : 6 ms (horn)
13 ms (reflector)
6 s cycle during 4 years (2 10^7 pulses)
150 kA (peak), 5000 A_{RMS}
Toroidal B field : 1.9 T max.

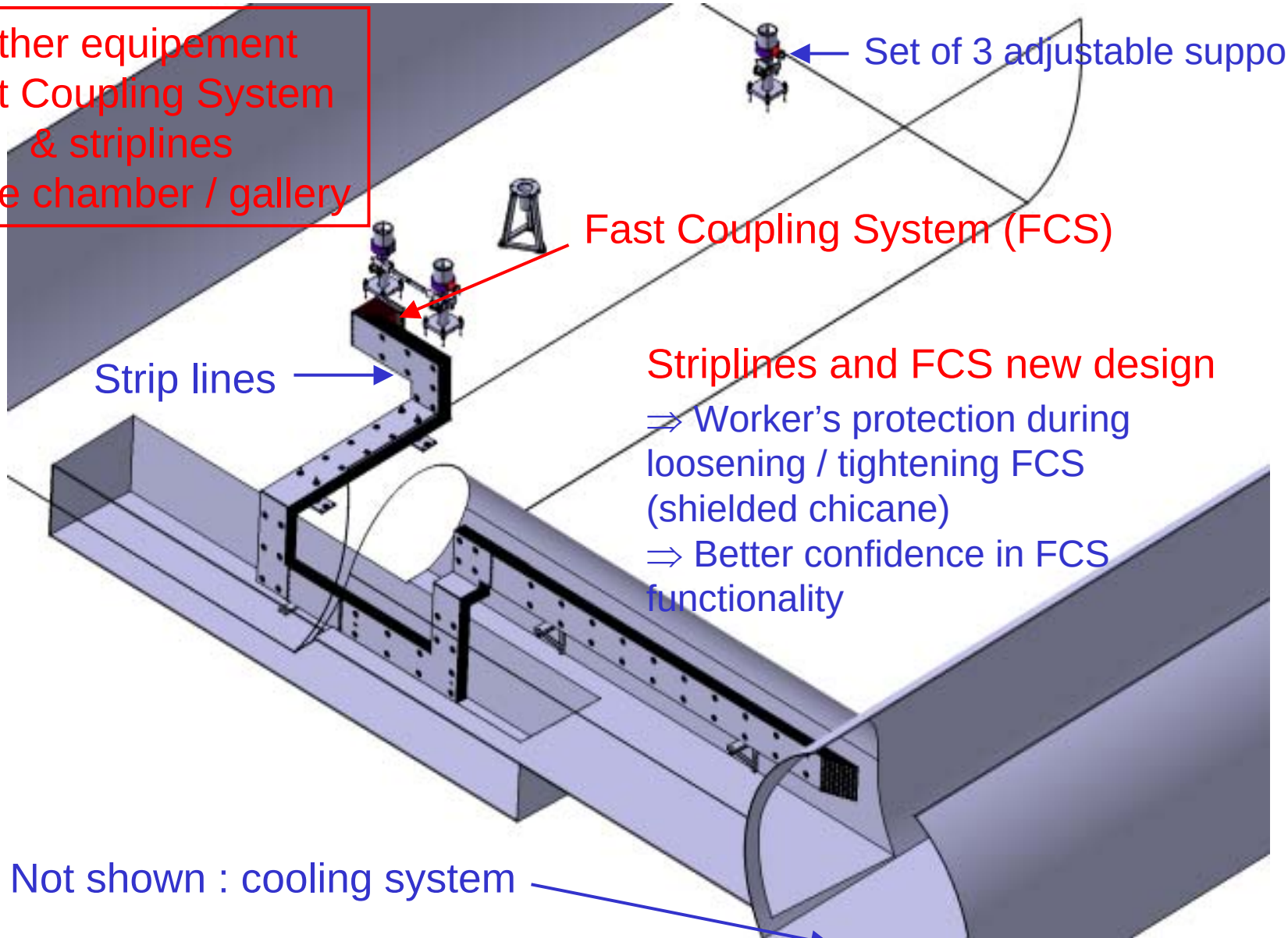
2. Design & studies

Full 3D design



Horn

2. Design & studies



2. Design & studies

Misc. studies done to guaranty functionalities
(especially for horn's inner conductor)

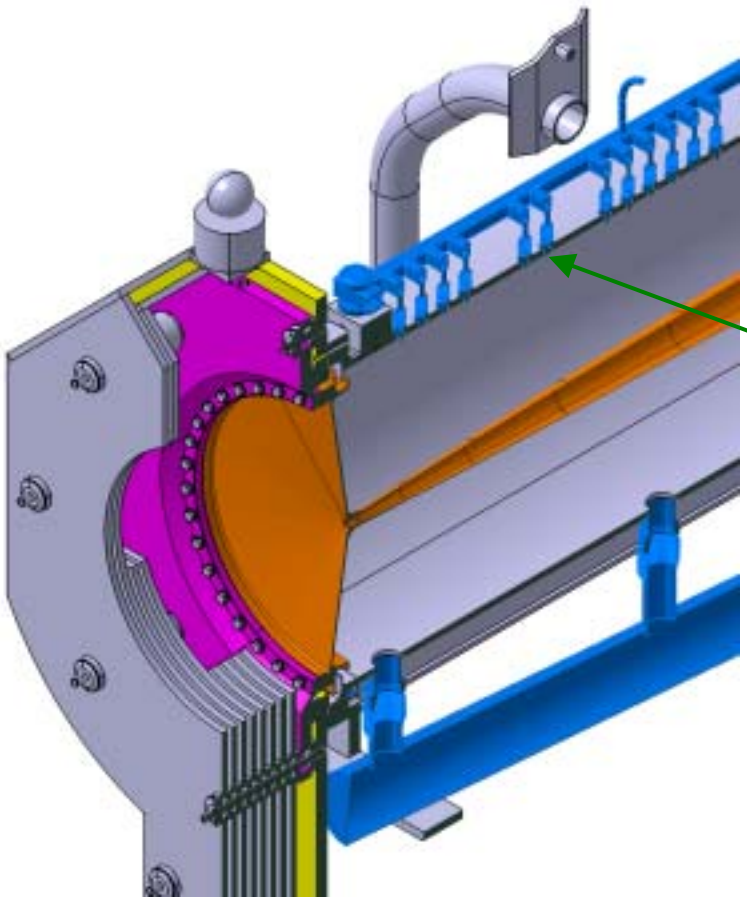
Status
Done

- Thermal : Deformation & Stress.
- Static : Straightness.
- Stability : Buckling.
- Dynamic : Fatigue-corrosion (4 years lifetime requested).

2. Design & studies

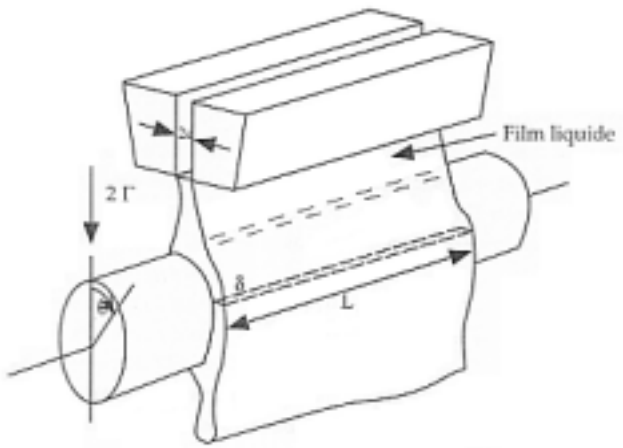
Thermal study

⇒ material behavior
⇒ thermal expansion, stresses



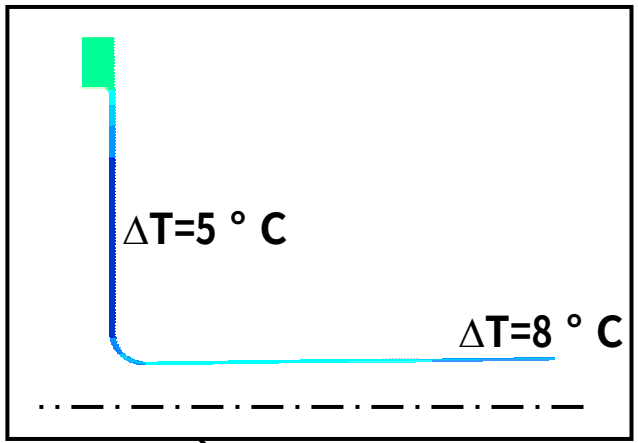
Heat load (inner cond.)
- 13 kW (Joule losses)
- 5 kW (radiation)

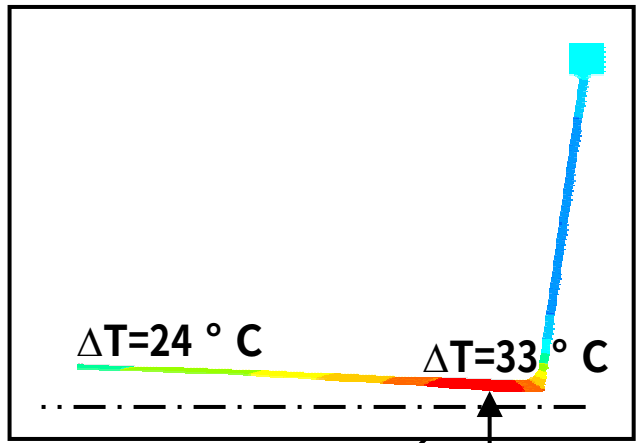
Water curtain falling onto inner conductor

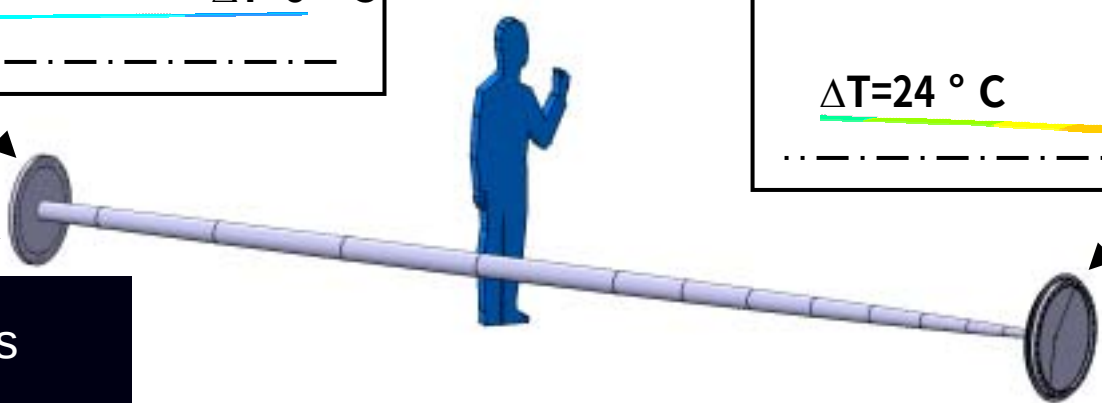


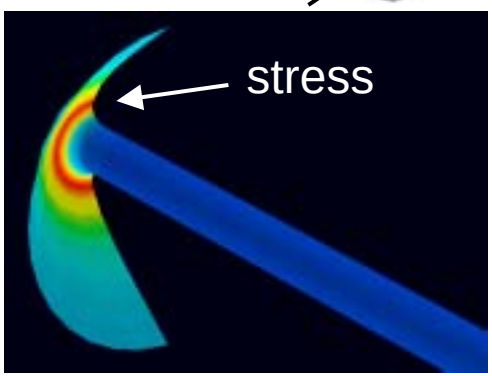
2. Design & studies

Thermal study









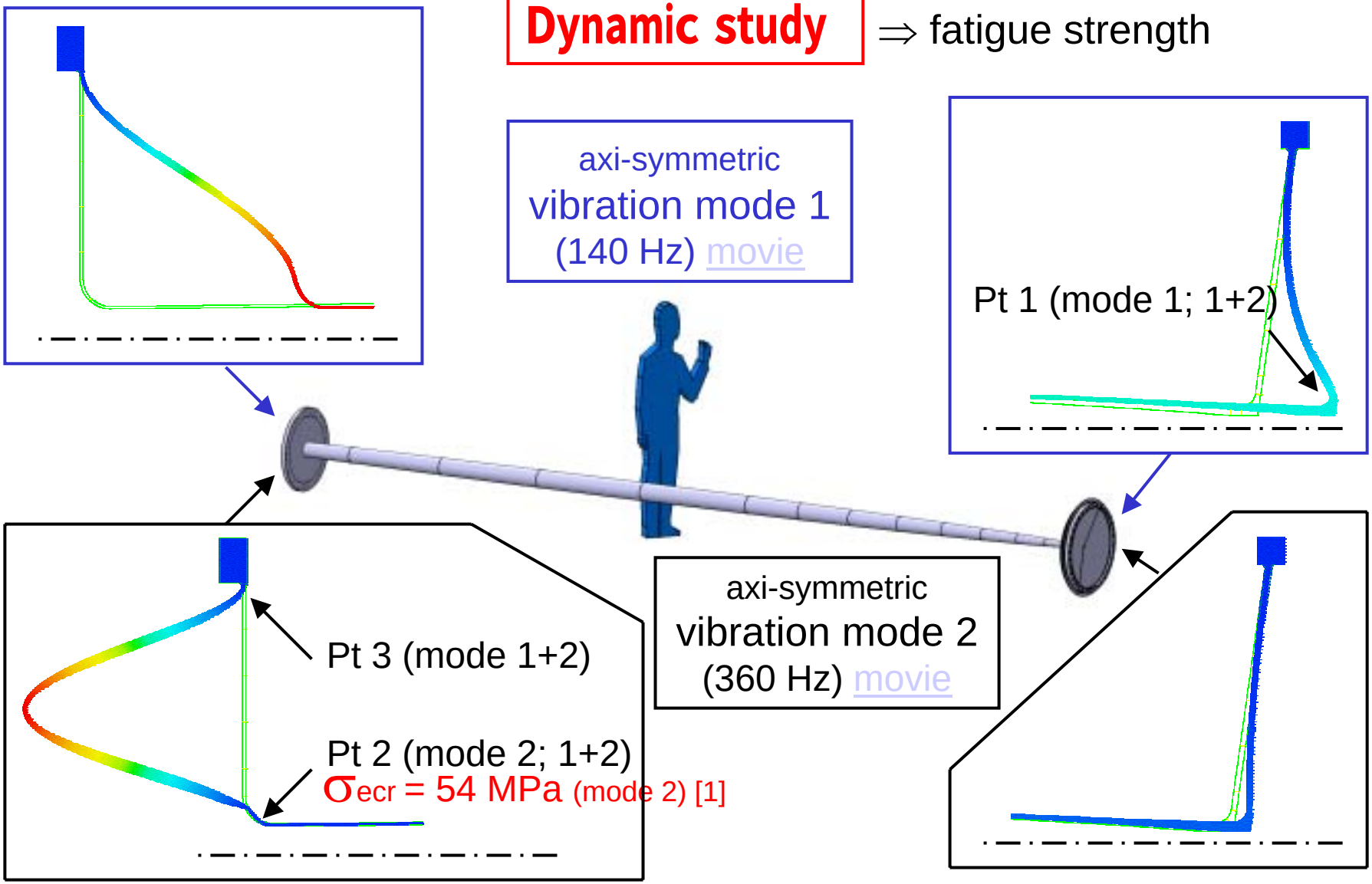
1.5 mm 'dynamic' thermal expansion enable by thin flange

$-0.75 < \Delta L_{dyn} < 0.75$ mm
(thanks to a 1.2 mm enforced displ. [ΔL_m=1.2 mm])

Cyclical thermal stress
$-10 < \sigma < 10$MPa

2. Design & studies

Dynamic study ⇒ fatigue strength



[1] : From Marek Kozien's Ansys study (Cern / Cracow university)

2. Design & studies

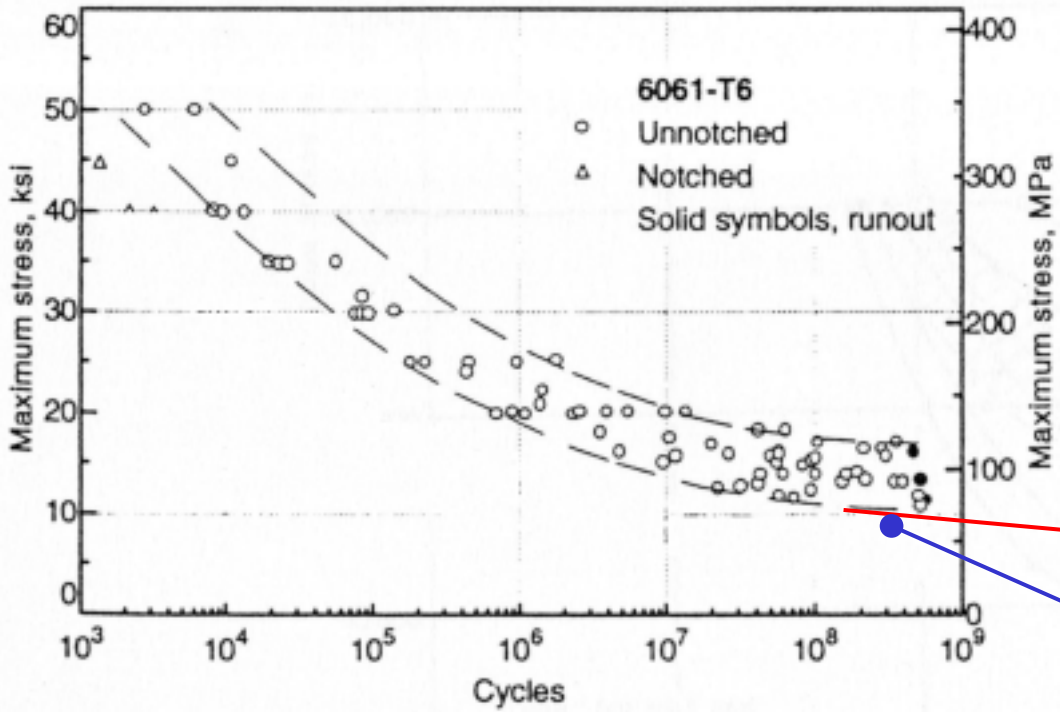


Fig. 70 6061-T6 notched (radius at notch root <0.001 in.) and unnotched rotating beam fatigue at room temperature. Solid symbols indicate runout (no failure). Longitudinal and transverse specimens from extruded bar (5/8 x3.5 in.), rolled-and-drawn rod (0.75 in.), and rolled plate (1.25 in. thick). R.R. Moore specimens with 9-7/8 in. surface radius and 0.300 in. minimum diameter for unnotched specimens. Notched specimens had a 0.330 in. diameter at the notch and a 0.480 in. diameter outside the 60° notch. Source: Alcoa, 1960

Fatigue strength

Warning
Infinite lifetime
do not exist!

thermal + mechanical stresses :
we are below the envelope curve

3. Manufacture & checkings

Large parts

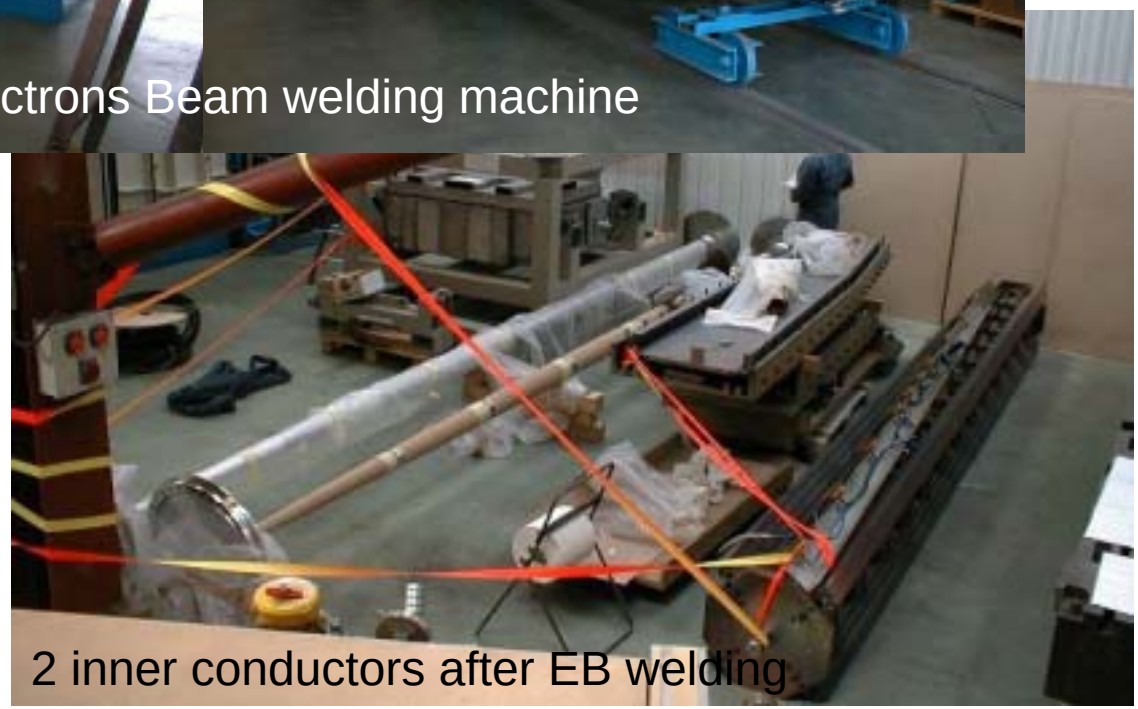
Status
Horns 1 et 1b : done
Reflector : done


outer conductor


electrical connection

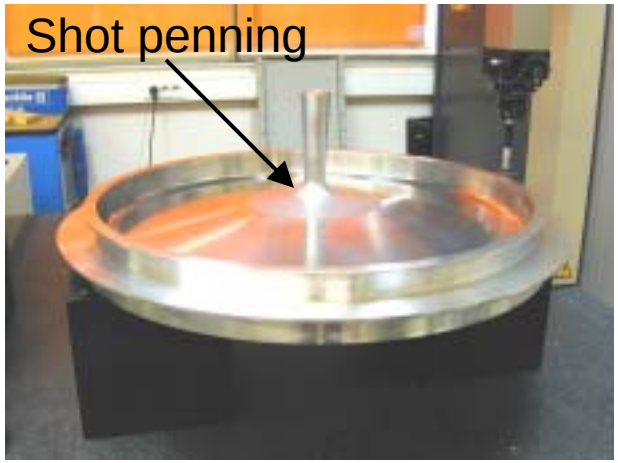
3. Manufacture & checkings

(large) Electrons Beam welding machine



2 inner conductors after EB welding

3. Manufacture & checkings



inner conductors

Horn flanges' checkings (after machining)
→ Ultrasonic
→ X ray
→ geometrical

Horn tronconical parts' checkings
(after machining)
→ Dye penetrant

Horn inner conductors' checkings (after welding)
→ X ray (for welds)

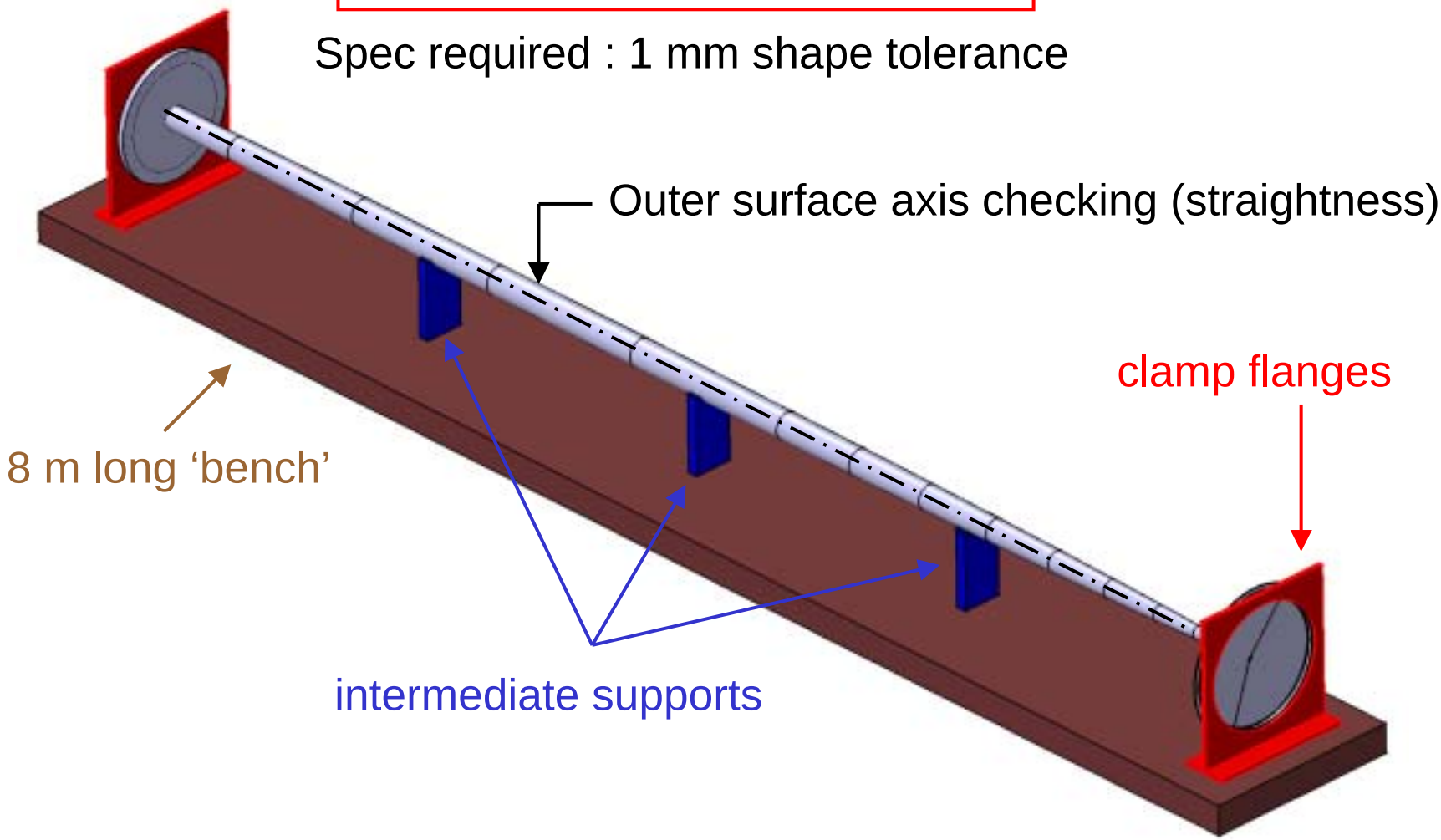
Reflector : cheaper processes used
- rolled & welded sheet
- TIG welding
- dye penetrant (welds)
- 3D checking

Status
Horns 1 & 1b : done
Reflector : production in progress

3. Manufacture & checkings

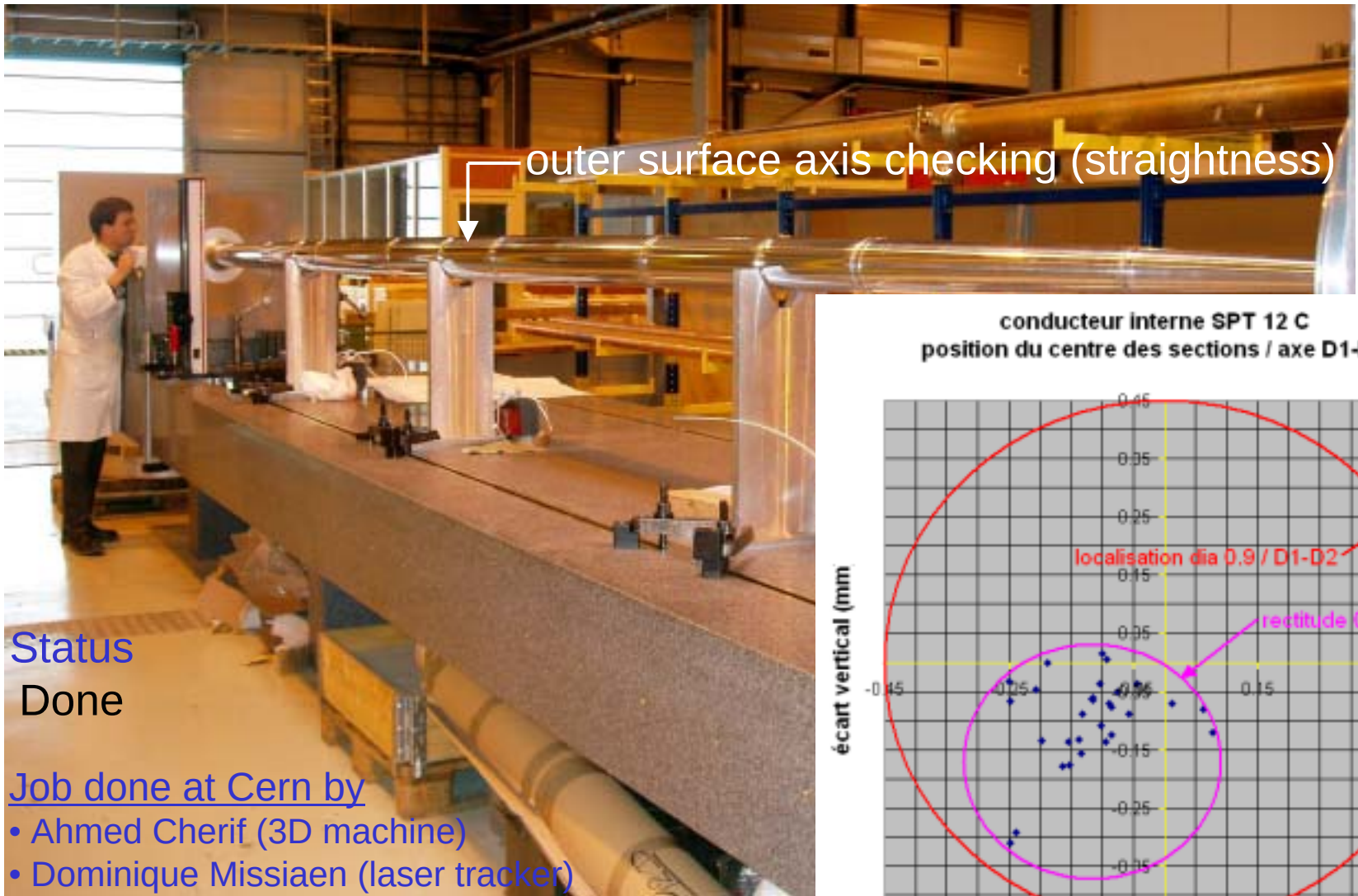
Inner conductor (final) checking

Spec required : 1 mm shape tolerance

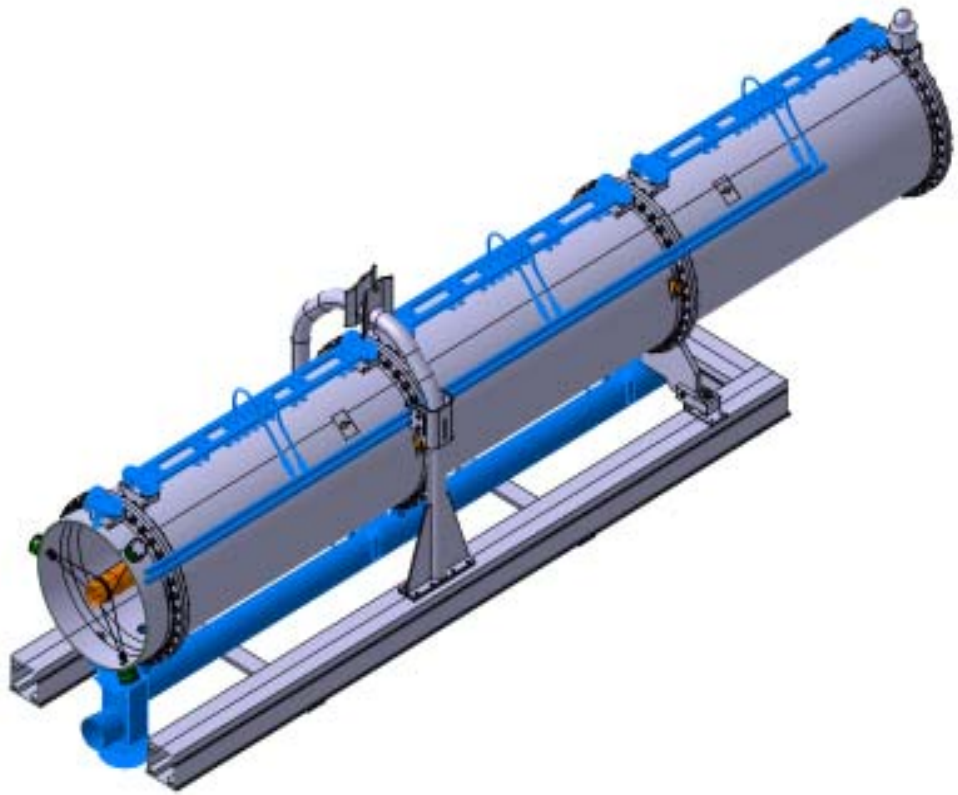


3. Manufacture & checkings

Inner conductor (final) checking (as done)



4. Mounting & adjustements



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4. Mounting & adjustements

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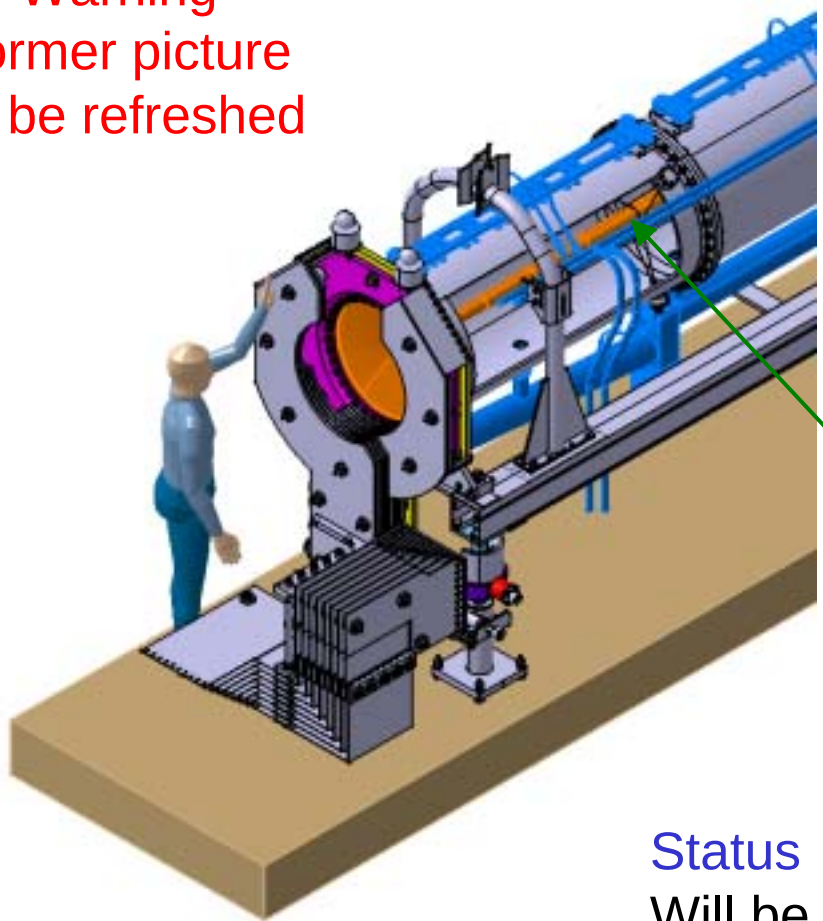
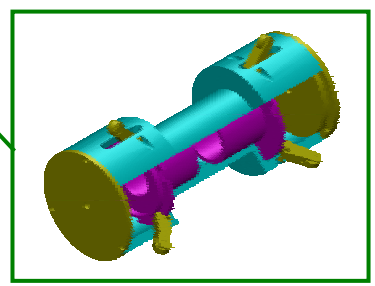
4. Mounting & adjustements

Inner conductor straightness adjustment

Warning
Former picture
To be refreshed



1. Put a self centering probe inside inner conductor
2. Check probe position
3. Adjust wires tensile force until to find correct alignment
4. repeat previous job for 2 others cables sets



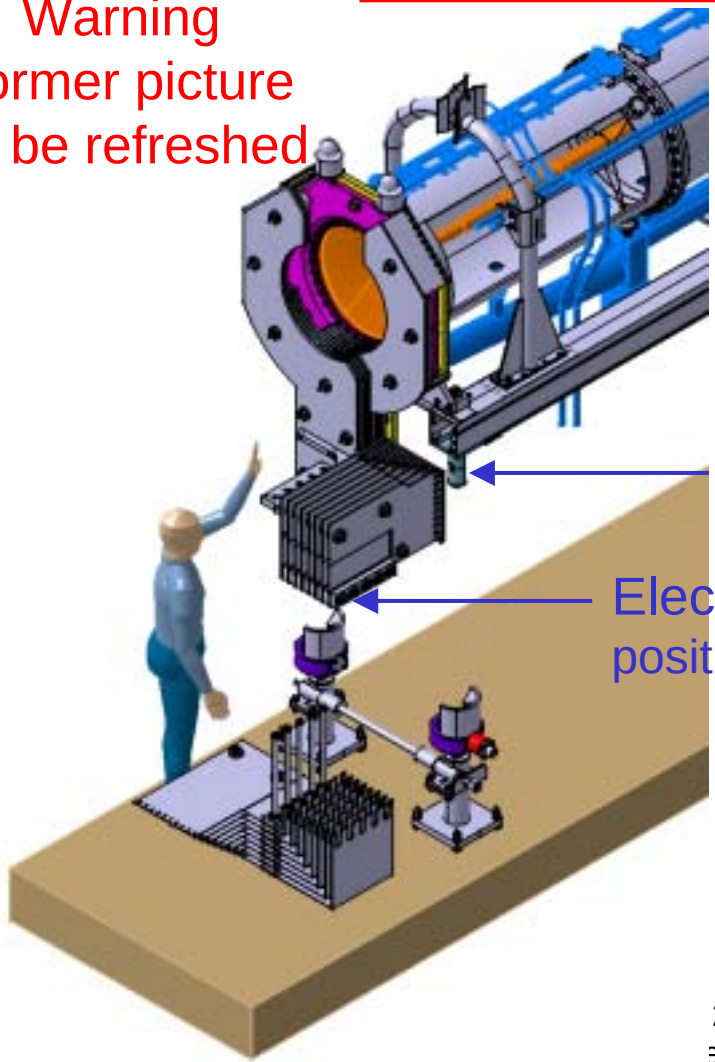
Status

Will be performed at (by) Cern within 2004

4. Mounting & adjustements

Centering stems & electrical connection adjustments

Warning
Former picture
To be refreshed



How to achieve interchangeability between horn and spare horn?

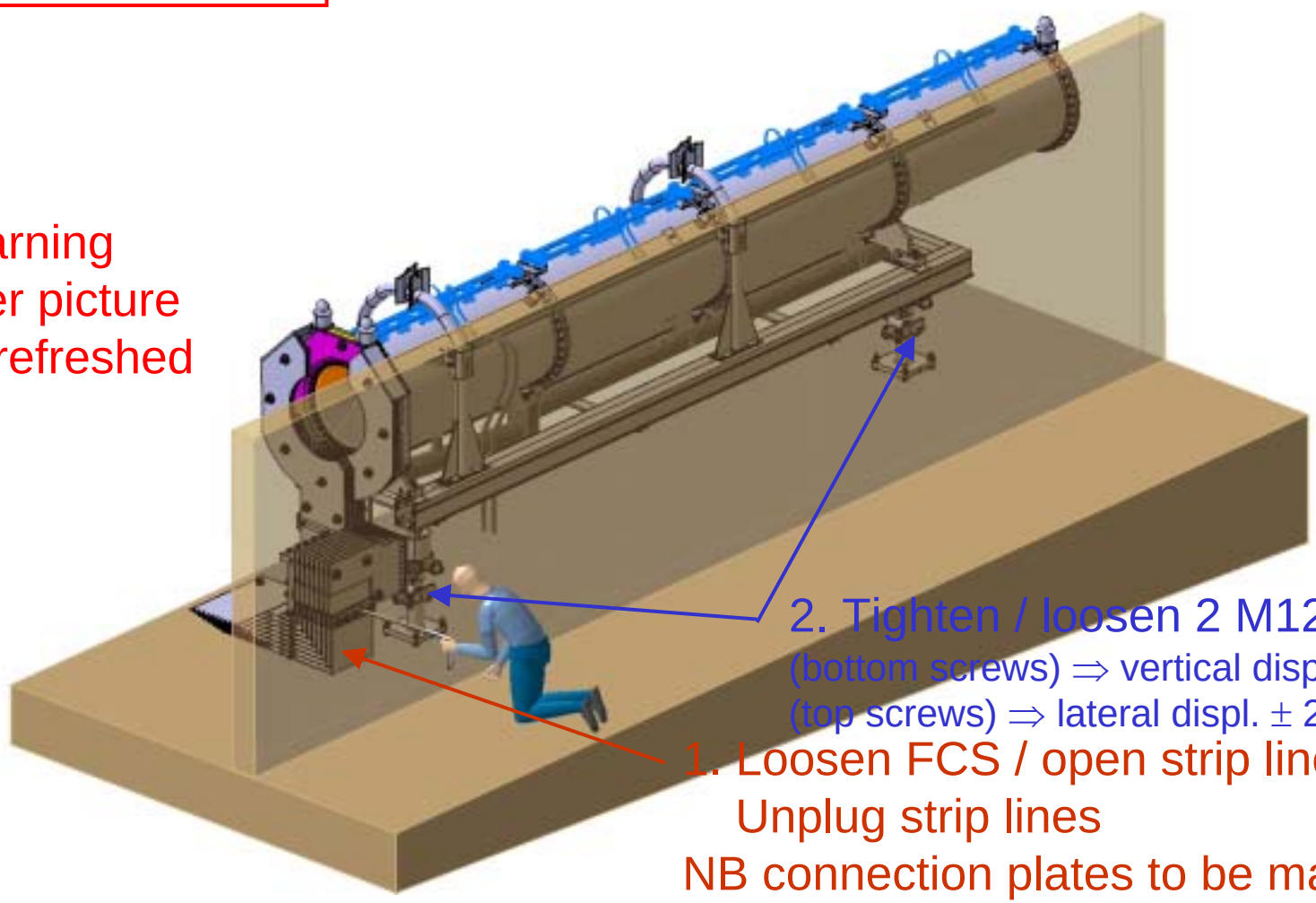
Centering stems :
position adjustment / inner conductor axis

Electrical connection :
position adjustment / inner conductor axis

4. Mounting & adjustements

Horn axis adjustment

Warning
Former picture
To be refreshed



2. Tighten / loosen 2 M12 screws
(bottom screws) ⇒ vertical displ. ± 20 mm
(top screws) ⇒ lateral displ. ± 20 mm

1. Loosen FCS / open strip lines /
Unplug strip lines
NB connection plates to be machined

5. Summary

Horn manufacture : done, except FCS (production review within 1 month)

Reflector manufacture : done, except inner conductor (to be deliver within january 2004)

Non-conformity trouble : solved

Adjustable support : jack received, other parts to be manufactured

FCS & Striplines : design to be completed (production review within 1 month)

Cooling system : ready for production review?

Mechanical tests in progress (S. Rangod, G. Maire) : picture

Electrical tests (horns, reflector, FCS) within 2004