WG1 TECHNICAL COMMISSIONING
OF THE TESLA LINAC - SUMMARY -

PRESENTED BY P. CASTRO

• Test all subsystems
  ➞ as soon as possible

• Commission systems
  ➞ as soon as possible

• Get started with beam
  ➞ as soon as possible

because we want:
• to find and fix problems a.s.a.p.
• to get experience and establish procedures a.s.a.p.
• to debug controls/software/etc. a.s.a.p.

because we want
LUMINOSITY a.s.a.p.
Earliest systems to be installed:

- injector(s) for the electron linac (end of 3rd year?)
- injector for XFEL (?)

We suggest:

- civil construction
- installation work
- need: dump + shielding
- tunnel closed
- goal: full performance

a.s.a.p.
Can we learn from TTF commissioning?

R. Bankmann proposes:

- To organize a working group to study in detail the difference between TTF and TESLA common.

**Subsystems**

- Vacuum - K. Zapfe
- Cryogenics + cryo modules - B. Jevs
- RF - S. Choroba / S. Simrock
- Controls - M. Rehlich
- Interlocks - M. Jablonka
- Water system -
- AC - power -
- Beam diagnostics - H. Wendt
- Global accelerator network -

organizers - M. Jablonka
Figure 4.1.3: Time schedule of work for civil construction (bottom) and for the installation work (top). Tunneling starts from four points along the tunnel in parallel and proceeds towards the interaction region. Civil construction, infrastructure work, and accelerator installation happen concurrently at different regions in the tunnel.
Linac commissioning

- commission every single, independent cryogenic linac unit (about 2.5 km)

end of cryo-linac unit installation

↓

close tunnel (use shielding)

↓

commission klystrons

warm coupler conditioning
off resonance

↓ cool down (a.s.a.p. to check for leaks, etc.)

resonator tuned
high gradient tests

note: no access to tunnel while klystrons are ON

→ all klystron checks with klystrons OFF
Linac commissioning

- commission every single, independent cryogenic linac unit (about 2.5 km)

end of cryo-linac unit installation

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cavities tuned
high gradient tests

note: no access to tunnel while klystrons are ON

→ all klystron checks with klystron OFF
dump

only shielding needed (moveable?)

startup beam

dump

full performance

startup beam

full performance

startup beam
The diagram illustrates the progression of phases over time, starting from "INJECTORS (500 MeV)" and moving through "5 GeV", "Cryo I", "Cryo II", "Cryo III", and finally "WORK".

Key milestones include:
- High-grade cold equipment
- Warm cond.
Linac commissioning with beam

Prerequisites:
- 5 GeV beam input
- all systems ok (until the dump)
- polarity of all cold quads on
- BPMs self-triggered [measure 1st bunch change]

Conditions for 1st beam through:
- zero gradient
- 1 bunch ~3 nC
- poor emittance (blown up by graphite fuel) at 500 MeV
- quads for 5 GeV lattice

Procedure:
measure x, y  \rightarrow  correct  \rightarrow  dump (by pass)

To set cavity phases ±5°:
- 3 bunches

commission diagnostics
machine protection system (100 kHz)

Measure energy, stability, optimize steering
Machine protection system

What could fail?

- Magnet power supplies
- RF - trip
  - quench (1 ok, many unlikely)
- Cryogenics
- Vacuum
- Kinetics + electrostatic separators

If slow \( \rightarrow \) BLS: beam interlock system

If fast \( \rightarrow \) fast detected at collimator with beam loss monitors \( \rightarrow \) by pass

If RF goes wrong before 100ms before flat top \( \rightarrow \) inhibit beam

How to re-establish beam?

- Go to 1 bunch and low rep. rate
Commissioning of long pulses
tog with 'undamped' beam
\[ \rightarrow \text{to test beam loading compensation} \]

Commissioning of final focus beam line
measure Emittance

\[ \rightarrow \text{test beam-based alignment} \]
study collimation and tails (beam loss monitor, needed)
tune linac with c-bumps
test extraction of beam

\[ \rightarrow \text{needs shielding of I.P. Hall} \]

Commissioning of c-damping ring
in parallel (with alternating extinction)

Commissioning full e-linac
Commissioning of e+ linac

What is different from e- linac?

- collect e+ from target
- auxiliary e- source on IP site
- 5 GeV (pre-linac) = IP source

...to be commissioned as soon as possible!

We propose to start

infrastructure work
+ installation work

from IP to 'West end'

and a 5 GeV dump at the end of pre-linac

1. Commission pre-linac with e- beam
   (eventually test e+ capture at low charge)

2. Commission pre-linac with e+ beam
   (prereq: e- linac with beam to dump)

3. Commission e+ linac with e- until IP

4. ... with e+
   (e+ dumping ring in parallel)
Luminosity Commissioning

Start with high $\beta$ in I.P.

- What can we test?
  - Adjust timing (with stripline BPM: $\approx 1$ ps)
  - Fast collisions
  - Commission fast feedback
  - Easier to collide
  - Less sensitive to wakefields, misalignments, etc.
  - Difficult to see effect of luminosity
    Optimization procedures

Go to low $\beta$ in I.P.

- Fine tuning with luminosity
- Extraction of disrupted beam after I.P

HEP

When is the detector going in?