CTF3 machine protection system (CTF3 MPS)

David Belohrad
comments/questions: david.belohrad@cern.ch
CTF3 collaboration meeting, 30. September 2003

General facts

- MPS protects CTF machine against the consequences coming from 'bad' transfer of the particles from CTF3 linac source to CLEX/intermediate dumps/spectrometer lines.
- In case of 'bad' transmission MPS affects beam production to fall on a safe situation
- MPS must be very fast, autonomous and as independent as possible of the control and timing system
- MPS does not protect humans

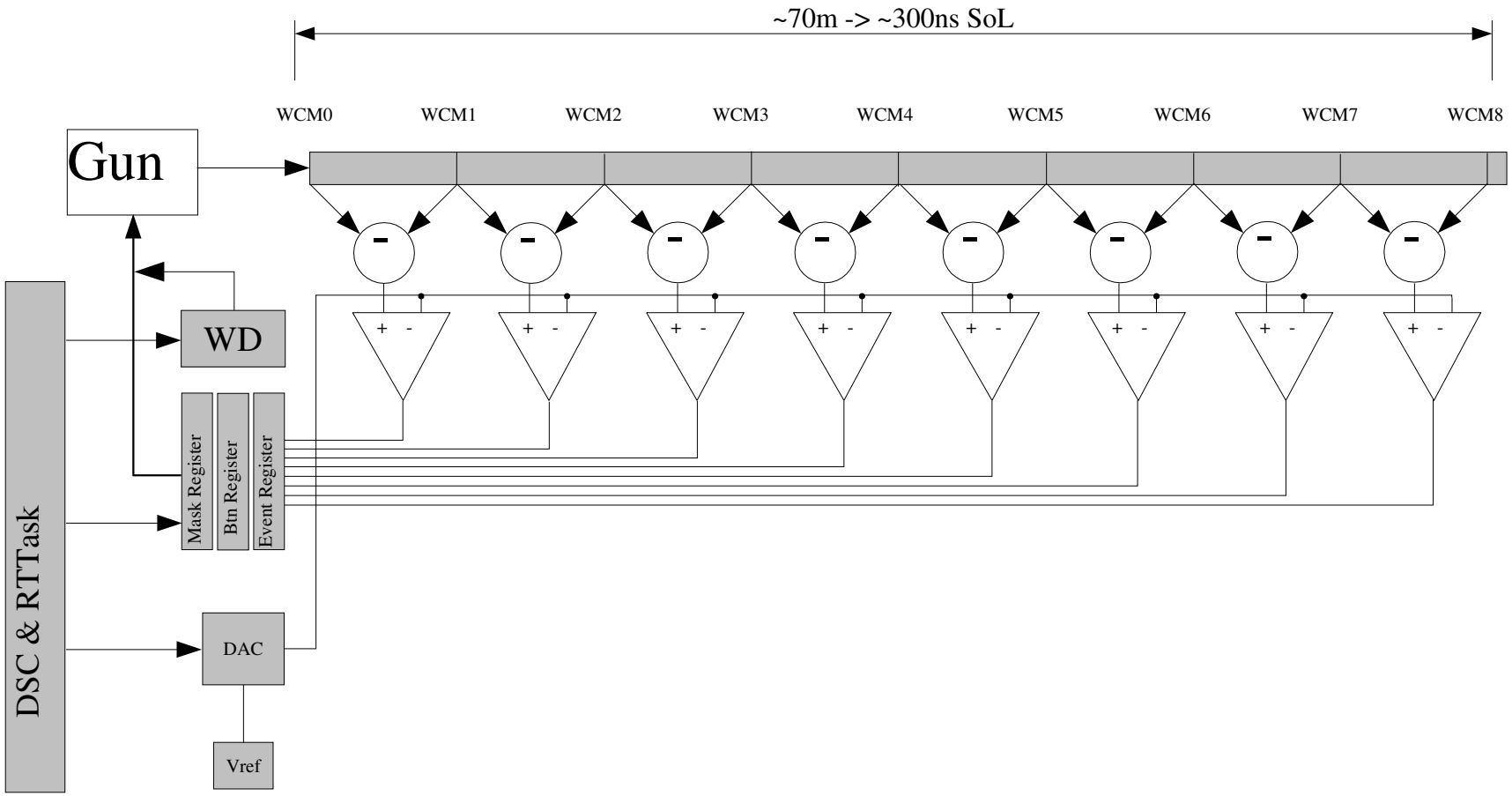
Bad transfer (1)

- Small repetitive losses < 10 – 20%
  - They don't damage the hardware
  - They raise personnel radiation hazard
- Action taken:
  - MPS should either decrease beam production or stop the beam in order to lessen radiation

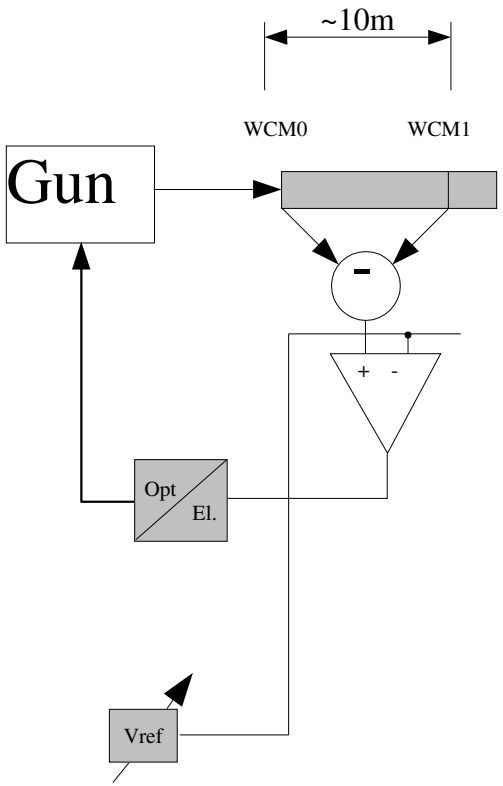
Bad transfer (2)

- Fraction of beam pulse lost locally
  - damages the hardware
- Action taken:
  - MPS stops the LINAC source beam production inside the present pulse
  - Apply recovery procedures
- Note – definition of beam loss
  - Beam loss is given by difference of beam charge measured at two consecutive sensors (WCMs)

Proposed solution (1)

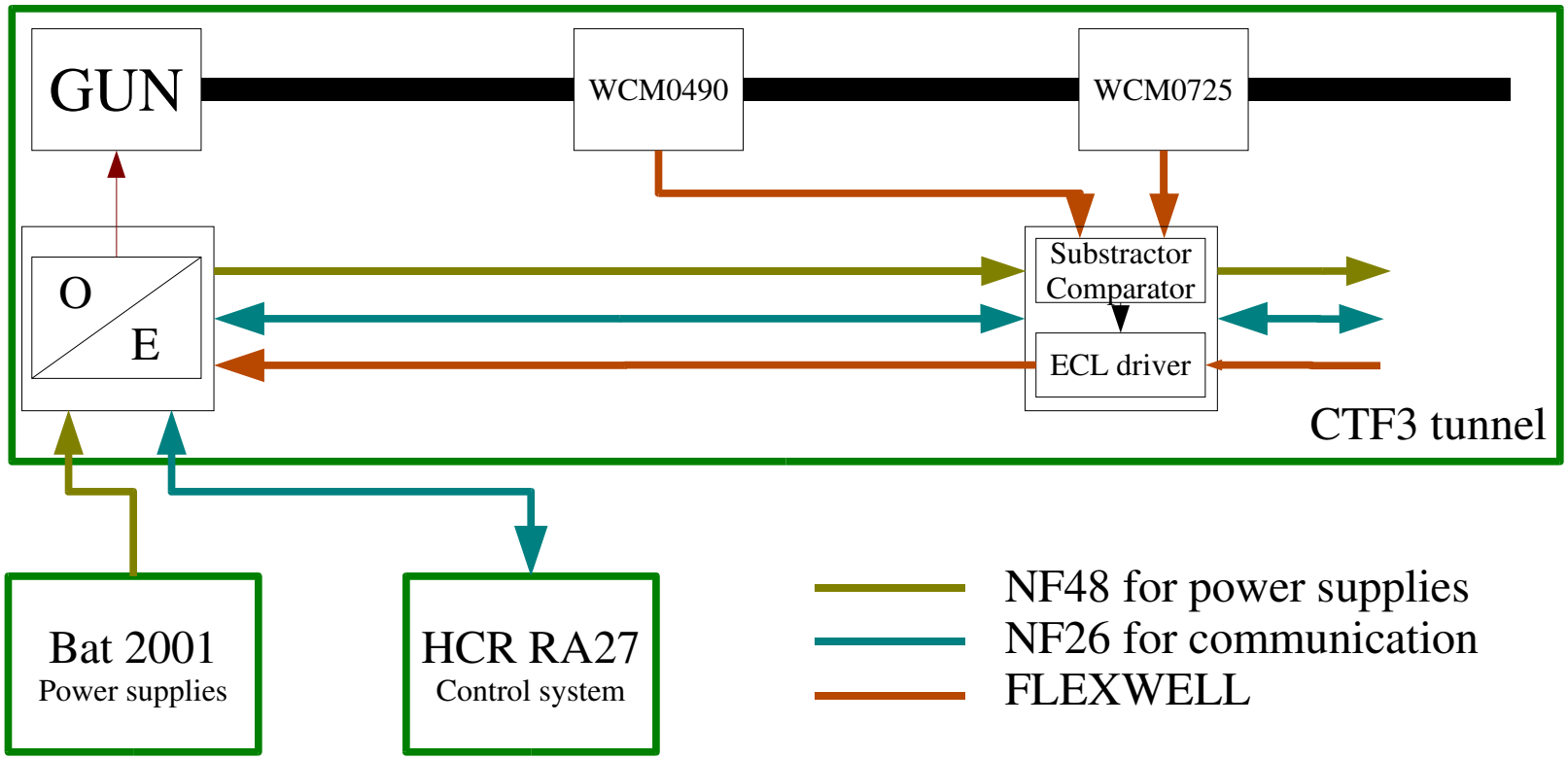


Proposed solution (2)



- In the first stage only 2 WCMs are installed
- Basic part of the system + infrastructure is built to test the speed of the system

Infrastructure



Speed

- Some facts about the speed of the system:
  - WCM time to react t_{PD1}=8ns
  - substractor electronic delay measured to be t_{PD2}=16ns*
  - FLEXWELL cable from WCM1 to substractor t_{PD3}=43ns**
  - FLEXWELL cable from WCM2 to substractor t_{PD4}=10ns**
  - FLEXWELL cable from substractor to E/O t_{PD5}=125ns**
  - electrical/optical conversion + ~4m of the cable t_{PD6}=50ns**

Delay from WCM2 to GUN: t_{PD_GUN}=8ns+16ns+10ns+125ns+50ns=209ns -> delay from beam passing WCM2 to stop the gun

This gives us the minimum reaction time to stop the gun: t_{react}=66ns***+209ns=275ns

* from crossing of the threshold to ECL signal output
** estimated parameter
*** 66ns is the ToL from Linac source to WCM2 in the distance of 20m

Conclusion

- In the near future first stage of the system will be installed. This stage is focused on:
  - make a basic functionality of the system, 2 WCMs are used
  - study of the behavior of the machine (noise, offsets...)
  - study/selection of the best control system
- There is not a lot of possibilities to improve speed of the system (the longest cables will be around 80m!) - for distant WCMs is difficult to react within the current pulse