
# WELCOME TO THE 4th RADWG & RADMON WORKSHOP

1 December 2004

# Effects of radiation on equipment installed in the LHC tunnel and service caverns

- Seen by the LHC project management as extremely important.
- It has of course been understood as a major problem for the high luminosity experiments from the earliest days.
- Radiation doses were already taken into account for the machine when it was decided to place electronic equipment under the arc magnets (mainly for economic reasons)

# TCC minutes of 24 January 1997

"*The committee recommends that the base-line machine should use, where advantageous and following suitable testing, electronics located in the arc tunnel. This is based on the understanding that the radiation levels will be kept to less than 1 Gy per year in the area around the main dipoles and that suitable resources will be made available for adequate radiation testing*."

# It was not expected to be too difficult because:

- In any superconducting collider local losses must stay below the quench limit in the superconducting magnets.

- Radiation simulations indicated that annual doses under the arc magnets will not exceed a few Gray per year and this was believed to be acceptable.

# Since then:

- Testing of components has put greater emphasis on single event upsets where instantaneous hadron flux is more important than integrated dose.
- Further radiation simulations have shown that radiation fields in specific areas around the LHC can be far higher and vary strongly as a function of machine operating conditions. For example beam cleaning giving losses in IR7 and collisions in IR1 and IR5.
- The need for equipment in the tunnel and service areas is also better understood and will exceed what can be accommodated in the “quiet regions” e.g. It is now planned to have electronics racks under the dipoles in the dispersion suppressors.
- It is essentially impossible to avoid a lot of potentially sensitive equipment in the service caverns around IR3 and IR7.

# Radiation testing in CERN (TCC2) and elsewhere

- Increase in beam-time with 60 MeV protons at PSI/UCL
  - 1998 - 0 hrs
  - 1999 - 0 hrs
  - 2000 - 8 hrs
  - 2001 - 15 hrs
  - 2002 - 16 hrs
  - 2003 - 95 hrs
  - 2004 - 78 hrs
- No more beams, including TCC2, available at CERN until 2006

# It is now clear that:

- A greater understanding is needed of the sensitivity of equipment (much of it already ordered in standard form) to the local radiation fields.
  - example - Oxygen Deficiency system
- More simulations are needed to better understand newly “discovered” areas with “interesting” radiation fields as a function of machine operation.
  - example - RR73,RR77,UJ76
- It is now clear that it will be necessary to monitor radiation fields during early commissioning of the LHC in order to prepare for high intensity running and prepare appropriate shielding or other measures.

# In conclusion

- Collaboration with the LHC experiments the Space Agency and other labs with similar radiation tolerance problems is very important.
- The situation in the machine areas at this moment is probably more difficult than in the experimental areas.
- A great deal of interesting work remains to be done to ensure that radiation effects do not make commissioning of the LHC even more difficult than expected as a result of frequent failures of equipment (including SEU's) in the tunnel and service areas.
- It is essential to have a radiation monitoring system adapted to the needs of radiation tolerance understanding, from the first day.