

LHC injector Chain, E.A., Facilities.
MTTR, spare parts and stand-by
policy for BI equipments

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on behalf of BI Group

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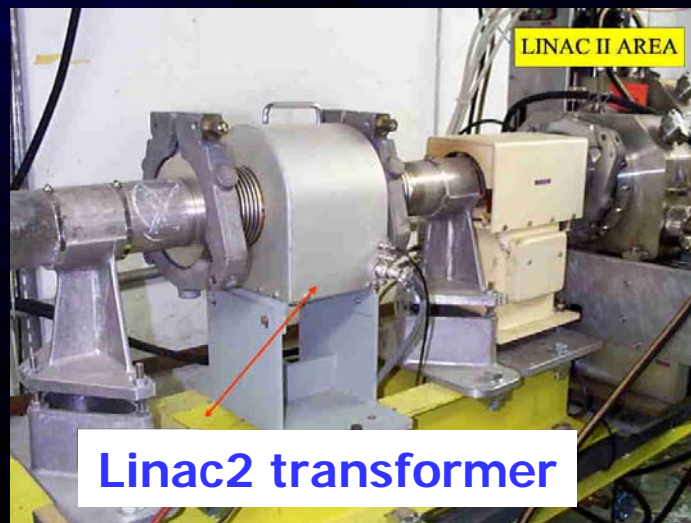
ATC / ABOC Days

Outline

- LHC injector Chain
 - Critical Elements : beam stop risk
 - Unavailability of Measurements
- Facilities & Experimental Areas
- Standby Policy
- Conclusions

Critical Elements : BCT (1)

- Transformer types
 - Fast : Transfer Lines, **13 units**
 - Slow : Linacs, LEIR, PSB injection, **31 units**
 - DCCT : PSB, PS, LEIR, SPS : **9 units**
 - Specials : PS 6-turn transformer, LEIR injection...



Critical Elements : BCT (2)

- Ceramics beam pipe BCTs
 - **Problem : Vacuum leaks**
 - **Beam stop risk : YES**
 - MTTR : 1-2 days if ceramics is available
 - Risk in the past : **ONLY During handling/installation**
- Cables and connectors
 - **Problem : Radiation damage ⇒ Linac 2 watchdog**
 - **Beam stop risk : YES**
- Ceramics : Few spare parts.
- Electronics :
 - **Problem : Machine protection / Watchdog**
 - **Beam stop risk : YES**
 - Linacs + Rings OK,
 - Transfer lines about to be consolidated towards LHC standards
- Special transformer have no spare parts : no toroids, no ceramics



Critical Elements : BLMs

- **Problem : Machine Protection**
- **Beam stop risk : YES**
- **200** ionisation chambers for SPS
- **200** photo-multipliers (ACEM) for CPS
- MTTR : 2h
- Electronics : 2h
- Cables : Shutdown
- 5 to 10% in storage for SPS
- 5 to 10% in storage of ACEMs for CPS (electronics needs repair, consolidation program is waiting for approval)

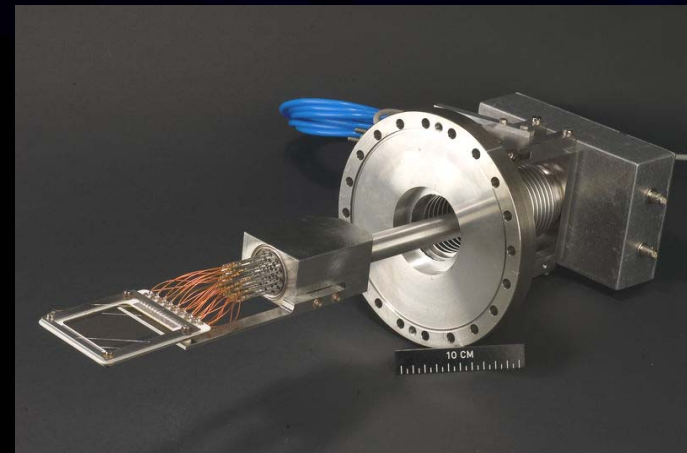
Critical Elements : Phase PUs

- **Problem : No acceleration**
- **Beam stop risk : YES**
- PSB : all under AB/RF responsibility
 - **5 PUs** per ring (dated 80's)
- PS protons :
 - **1 WCM** in section 95, good shape, no spare
 - Electronics and spares boards OK
- PS ions :
 - **2 units**, section 83 and 93
 - Low failure risk
 - Electronics : tubes amplifiers, spares OK



Critical Elements : Intercepting Devices

- **Problem : vacuum leaks (bellows) + Mechanical in/out problems**
- **Beam stop risk : YES**
- **TV screens : 100 units**, electronics & spare parts OK
- **FWS : 24 units**
 - Broken wire : 1 day
 - Cables : shutdown
 - Electronics, MTTR : 2 h
 - Consolidation on the way : mechanics + electronics
 - Some parts in storage
- **SEM Grids : 241 units**
 - Broken wire : 1 week
 - Cables : shutdown
 - Electronics : OK, MTTR : 2 h



Critical Elements : LEIR e-cooler

- **Problem : No phase space cooling**
- **Ion beam stop risk : YES**
- Gun, cathode and collector : 1 spare of each
 - Intervention duration on each element : **up to 2 weeks** down-time
- Four Magnetic elements : 1 spare of each
 - Intervention duration on each element : **up to 2 months** down-time



Unavailability of Measurements for LHC injector Chain

- Orbit / Trajectory Systems
- Ionisation Profile Monitors
- Tune Monitors
- Wall Current Monitors

Orbit / Trajectory (1)

- **Types of Beam Position Monitors :**
 - Magnetic : **20**, with ceramics insertion, 1 spare
 - PSB : electrostatics **16x4**, 1 stack spare
 - Transfer lines : **18** electrostatics, 3 spare ceramics
 - PS : **40** electrostatics, 2 spares
 - LEIR : electrostatics
 - **8** circular, 1 spare, MTTR : 1 day + baking
 - **8** rectangular in bendings, No spare
 - LEIR to PS : **14** electrostatics, 3 diameters, 1 spare of each
 - TT2/TT10 : **20** stripline couplers
 - SPS : **240** (216 single plane shoebox BPMs + a few others - striplines & large aperture BPMs)



PSB : BPM stack

Orbit / Trajectory (2)

- **No failure of sensor**
- CPS electronics : spares OK, MTTR : 1h
- TT2 / TT10
 - prototype system for CNGS plagued by many known bugs
 - no auto-trigger, acq. not optimal for single pass, complicated software
 - Consolidation request approved : awaiting final go-ahead
- SPS
 - **Problem : interlock linked to orbit extraction bump**
 - **Beam stop risk : YES**
 - Most components date from the early 1980's (amplifiers, RF comp., DAC systems)
 - Ageing system requires a lot of intervention (shutdown)
 - MTTR still low : spare parts available but obsolete components hard to find
 - Consolidation will be requested for MOPOS electronics in medium term future.



PS Pick-up

Other Diagnostics Tools

- **Ionisation Profile Monitors**

- SPS : **2 units**
 - If failure, then replacement during shutdown
 - Cables : shutdown work
 - Electronics : MTTR 2h
- LEIR : **2 new units** : spare chambers OK, MTTR : **one week** due to baking

- **Tune**

- BBQ based system + FESA server :
 - 2007 : **standard** system for PSB, PS SPS, LEIR
 - 2008 : all BBQ systems will be operational for machine start-up.
PS : Some remaining issues, BBQ will run in // with the old system
 - MTTR very short due to **standardisation** : spare parts are readily available
- Schottky : LEIR **4 sensors**, no spares, electronics OK, MTTR 1h

- **Wall Current Monitor**

- PSB : **4 sensors**, 1 spare vac tank, no ceramic spare
- PS : **1 sensor** in section3
 - Radiation damages : oxydised surface, and cable
 - Consolidation : study foreseen for 2008

Facilities & Experimental Areas

- ISOLDE
- AD
- East Hall / SPS North
- CTF3 / CNGS

ISOLDE (1)

- **Half a day for radiation cool down must be added to MTTRs quoted below**
- **TV screens**
 - **standardisation** of boards and cameras. MTTR = 2h
- **Scanners**
 - MTTR = Half a day
 - Few spare parts
- **SEM Grids**
 - 6 units, no spare for mechanics
 - Electronics OK, MTTR = Half a day
- **Faraday Cup**
 - Spares OK, MTTR = One day

ISOLDE (2)

- **Half a day for radiation cool down must be added to MTTRs quoted below**
- **Fixed Needle Beam Scanner**
 - Unique monitor used by an expert. No spare. MTTR = UNKNOWN
- **Tape station**
 - Few mechanical parts. MTTR = one day
 - Electronics : **dated 1974 !!**
- **REX instrumentation**
 - Few spare parts. MTTR = Two days
 - Electronics : bad shape. Regular technical hitches expected
 - Consolitation scheduled for 2009

AD (1)

- **Deceleration**

- Longitudinal Schottky monitors : **1 low freq unit + 1 high freq unit**, no spares
if sensor **USY4105** is damaged, **AD STOPS for one week**
- Electronics : Head amplifier : spare OK, MTTR = 8h

- **Electron cooling**

- gun, collector and cathode : one spare of each, **AD STOPS for 2 weeks**
- magnetic elements : unique spare for the drift solenoid.
- other magnetic elements : no spare. if damage = **AD STOPS UNTIL REPAIR**

- **Intensity measurements**

- Longitudinal Schottky monitors : TFA7049, no spare
- Electronics : Head amplifier : spare OK, MTTR = 8h

- **Tune measurements**

- BTF with Transverse Schottky monitors : no spare
- Electronics : Head amplifier : no spare
- **Orphan** system

AD (2)

- Orbit
 - **59 sensors +2** in e-cooler, ceramics + vac tank,
 - Electronics spares OK, MTTR 1 h
- Profile measurements
 - TV screens : **standardisation of** boards and cameras. MTTR = 2h
 - SEM Grids : **2 unit**, few parts, Electronics OK, MTTR = 2h
 - Scrapers + Scintillators : spare tubes OK.
 - Multi-Wires Prop. Chambers : 16 MWPC + 1 Gas Electron Multiplier
 - **Problem : not possible to setup the extraction**
 - Spare : Dectectors OK
Electronics : few boards, obsolete and **orphan**. **MTTR ??**
 - Consolidation : possible for startup 2010
(profit from new North Area standard)

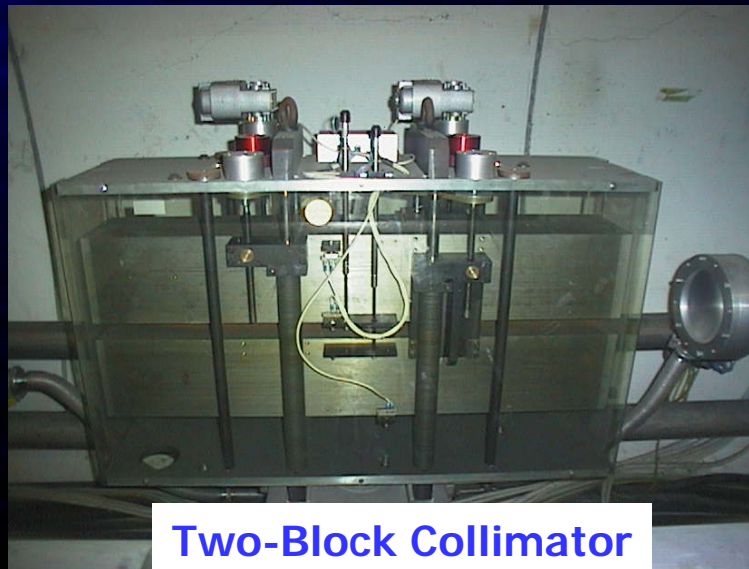
Experimental Areas (1)

- **Detectors for instrumentation:**
 - Consolidation of SPS **North Area** achieved (CAMAC -> VME)
 - Sufficient redundant instrumentation
 - Spectrometres and **CEDAR** : crucial for COMPASS and NA61
 - MTTR for CEDAR : **1 day + 2 days commissioning**
 - **East Hall** should profit from the newly renovation of the North Areas (Scintillators and Delay Wire Chambers identical)



Experimental Areas (2)

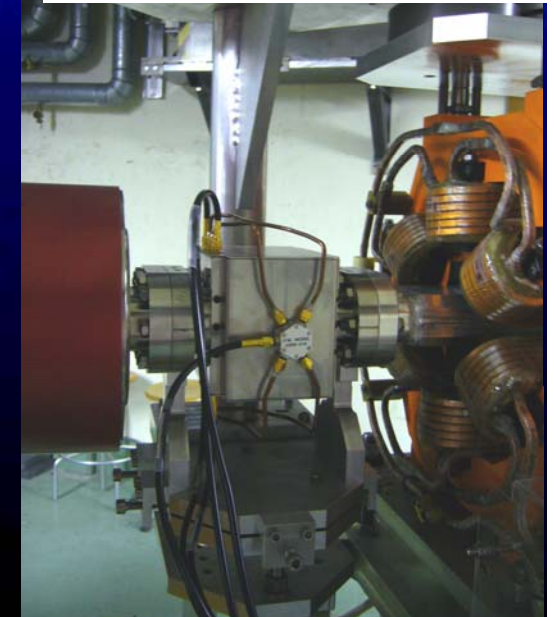
- Motorization of collimators, dumps, target absorbers...
 - **Problem : faulty motorized equipment**
 - **Beam stop risk : YES**
 - MTTR : Might be long depending on location and radiation issues
 - Mechanics is under ATB's responsibility
 - Software & hardware controls : obsolete (80's), no specialists
 - Renovation initiated 5 years ago
 - ATB has proposed a standardized controls system (1.5 MCHF !)
 - BI will transfer responsibility of these "none detectors" to ATB (2009 ?)



CTF3 and CNGS

- CTF3 :
 - **108 BPMs** (3 types : ceramics, button, magnetic), No spare
 - Electronics : OK, MTTR 1h
 - **5 Wall current monitors**, 1 spare, MTTR : 1 day
 - electronics OK, MTTR 1h
 - TV screens **renovation in 2007** of all controls boards and cameras
 - MTTR is short due to **standardisation**
- CNGS :
 - **Beam stop risk : YES**
 - **Problem : target BPM watchdog on proton beam position on target. Beam stopped if this BPM does not work.**
 - 5 striplines and 18 buttons PUs
 - Electronics : Autotriggered Log Amp electronics.
New system with enough spares
MTTR : a few hours

CTF3 Delay loop: BPI



Standby Policy

- BI group provides CCC a complete list of specialists on call for each equipment
- Until 2005, BI-EA had a Piquet Service for the SPS Experimental Area. After the renovation program this service is no longer needed

Conclusions

- Low probability of sensor failure
- Sensors fail less than electronics
- Real concerns about the lack of spare ceramic chambers for BCTs
- Strong consolidation effort still needed
- BI group provides CCC a list of specialists on call.

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