Controls Issues Through the Backbone

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with help of many colleagues

ATC – ABOC Days

23 January 2007

Preface

- This presentation will deal with the **controls issues in the large sense of the word** in the **LHC injectors** (i.e. SPS, PS, PSB)
- Linac 2 was discussed during the previous presentation by R. Scrivens.
- The **Pb ion chain** (Linac 3, LEIR and PS for ions) is **not considered** here.
- This presentation is **not exhaustive** and any additional issues worth discussing are welcome.

Topics:

- Injectors sequencing
- Machine control environment
- Working point control
- Beam diagnostics tools
- Interlocks
- Hardware Diagnostics tools
- OASIS
- "passerelle" for GM and FESA
- Equipment Installation or Renovation
- Conclusions

Injector Sequencing (1)

- **Sequences** and **super cycles** are **changed** with an **increasing rate** (see also talk J. Wenninger).
- **Missing tools** in the sequence- or super cycle **editor** make these changes very **time consuming and inefficient**:
  - Provide a **copy/paste** facility from show view to editor to copy part of another sequence or super cycle.
  - Have an **undo button** to avoid closing and opening application after editing error.
  - Add **history** to recall previously played sequences and super cycles.

Injector Sequencing (2)

- The **number of 'users'** limit for the **first machine** in the chain is the **most critical**.
- In the PS Booster nearly all (24) 'users' are allocated to specific operations.
- For the moment they can cope with 24, but when LHC starts requiring all beams this has to be reviewed.
- Part of the **problem** can be **by-passed** by using good working **archives**.
- The **SPS** has also reached the **limit** of 24 (16 freely useable, 8 used for pulse start, stop etc…).

More users require maintenance discipline but will make rapid super cycle changes more efficient

Machine Control Environment (1)

- CCM (Common Console Manager, JAVA)
  - Was **not operational** at the end of the **2006** run.
  - **PPM copy** and **archiving not reliable** and coherent.
  - **Very slow** compared to X-motif console manager.
  - **Colour codes** (faults, reference etc.) **not correct**.
  - **Very large** application **windows** and knobs size.

Software renovation should be done in order to improve a product.
Decreasing its performance is no progress

Machine Control Environment (2)

- LSA (SPS)
  - **The deployment was a success.**
  - **This shut down** some **debugging** and **polishing** will be done and the SPS should run full LSA at the end of 2007.
  - One comment:
    - Changes made in generic software at the request of one machine might have an impact on the functioning of another machine

Machine Control Environment (3)

- PS complex software applications
  - **Equipments** get **renovated** and become **FESA** → need for **GM to FESA adapter** or new applications.
  - **FESA – GM alarm handling** needs to be dealt with correctly (e.g. TT2 screens)
  - When **LASER** will be implemented for 2007, it should contain at least the **same functionalities** as the **X-motif alarm tree**.
  - Many applications recently developed (JAVA) had to be modified or rewritten in order to cope with the CO changes (ASC to JAPC, EdPlot to JDataViewer, Old Frame to New Frame)

Machine Control Environment (4)

- FESA
  - SPS profile measurements and BTV's (Nodal control) ?
  - The PSB transformers (later also BPM's)
    - **GM to FESA adapter Guinea pig**
    - At several occasions the transformers readings were not correct for a longer period of time, which caused extra complications for operations.
    - The **teething problems** are now **solved**.
    - **What next, under which conditions, how and who ?**
  - TT2 screens
    - Initially **complicated controls** and **no alarms** available.
    - We lost the proper naming of the screen positions
    - We had problems with support (CO or BI ?)
    - **What about remainder of the whole PS complex ?**

Who is responsible for what ?
Piquet or Expert service ?

Working Point Control

- SPS
  - In 2006 the **chromaticity control** (reproducibility) was difficult due to a **bug** in the **LSA** software, which was **corrected last summer**.
- PS
  - The **evolving control system** made the working point **editor outdated** (ASC to JAPC, EdPlot to JDataViewer, Old Frame to New Frame)
  - **Chromaticity measurement** was **re-written** last year
  - **Working Point control** application will be **re-written** for the 3rd time, now also for the **5-CM PFW control**.
  - The **PFW's** in 26 magnets were **changed** and the **responses** (matrices) seem to be **slightly different**.

Beam Diagnostics Tools (1)

- Tune (and Chromaticity Measurement)
  - PSB: Tune measurement VME electronics is broken and needs serious work.

Will it be available for 2007 start up ?

  - PS: Tune measurement not reliable (100 kHz noise).
  - Partial renovation foreseen, but no success guaranteed.
  - All PFW 5-CM matrices must be measured in 2007.

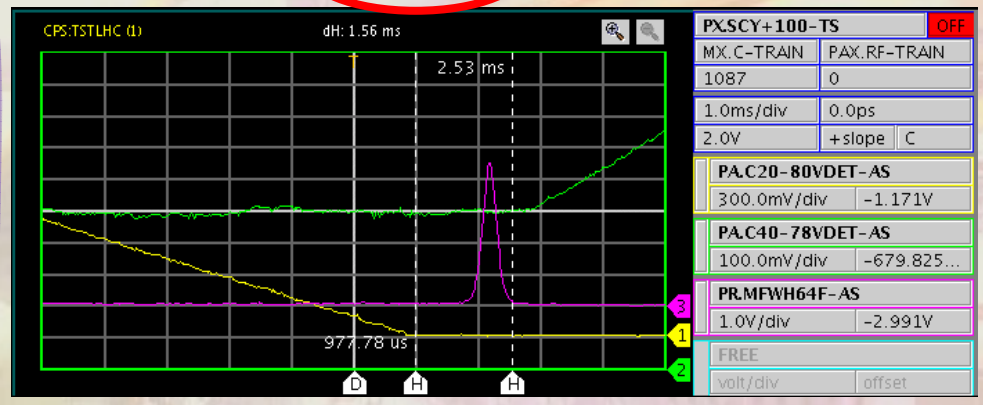
This cannot be done without reliable Q measurement.
Should more effort be put in to deploy the complete BBQ ?

Beam Diagnostics Tools (2)

- Fast Wire Scanners
  - **PSB**: The situation has **greatly improved** since long 2005 MD.
  - **PS**: Their movements are not always under control and a **lack of procedures to check functioning prior to start-up** identified (2 systems broken).
  - **PSB and PS**: The measured **emittance** and measurement **timing** are not the same for the different velocities.
  - **PSB**: not enough dynamic range to measure the **LHC Pilot beam** and the **ISOLDE beam**.
    - Additional PM's and filters required

Beam Diagnostics Tools (3)

- FWS at C1190 with v = 10 m/s



>1 ms error in a 2 ms time window to make a valid measurement for LHC at 26 GeV/c

- FWS at C1190 with v = 15 m/s

Beam Diagnostics Tools (4)

- Orbit and Trajectory Measurement
  - SPS:
    - Was **adapted for 75ns LHC beam**, but did **not** give **precise measurements** on any beam in 2006 (offsets). Hardware work is ongoing.
  - PS:
    - Dynamic range extended during 2005.
    - New **hybrids saturated** during magnetic cycle, which was **solved** during the start-up.
    - The **CODD** did not work during a part of the year due to **difficulties** coping with the **bunch splitting** processes.
    - New system under development for 2008 → application to be specified/written in 2007.
  - TT2/TT10:
    - No good trajectory measurement, **BPM's** are **installed** but **no software** available.

Beam Diagnostics Tools (5)

- PSB recombination trajectory measurement
  - **Electro-static or magnetic pick-ups ?**
  - Calibration of the pick-ups is not sure.
  - Steering sometimes lengthy and done using BLM readings.
- PSB TomoScope
  - CCC and BOR are in competition for the use, which causes a loss of time.
  - Only 1 reservation available.
  - **Adding a 2nd channel would be useful.**

Beam Diagnostics Tools (6)

- TT10 OTR screens
  - The **acquisition** of the OTRs screens in TT10 is **not reliable** and it is based on **old acquisition electronics**.
  - Should be improved this year.
- SPS fast BCT
  - **Bandwidth** of the bunch-by-bunch intensity measurement is not sufficient to measure precisely **bunch intensity** at the **edges of the batch or satellites** after the main batch.

Interlocks

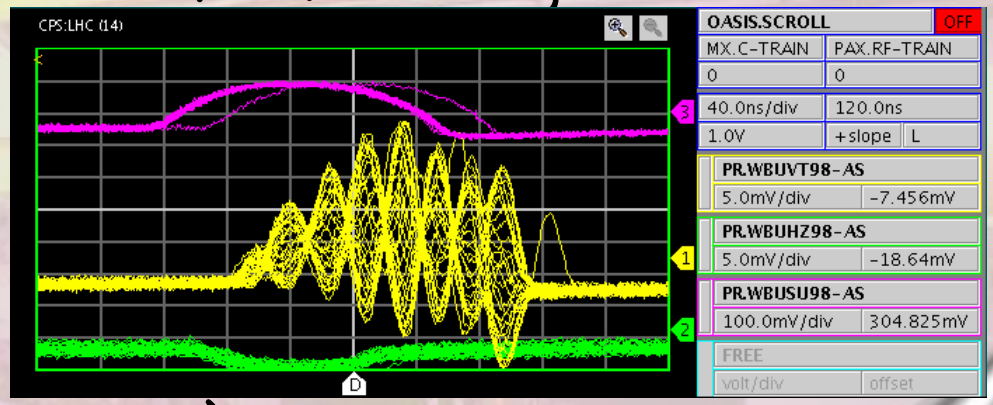
- Magnet interlock systems:
  - For the **SPS** the **responsibilities** seem to be more or less **clear**.
  - For the **PS complex** this is not 100% clear (cables, patch panels etc..).
- Other interlock systems
  - The SPS **CIS** is the main power converter interlock system (MPS, pulse start, pulse stop, etc…)
  - The computer based system (CIS) is getting **very old** (spare parts ?)
  - Is **renovation** foreseen ?

Hardware Diagnostics Tools

- **Decentralizing** front-end responsibility **requires more sophisticated hardware diagnostic tools** for the operator to be able to determine the type of fault in order to call the right person at 2 O' clock in the morning.
- Old **TIMDIAG** was promised to be available, but did not have the full functionalities. A new version is underway **hopefully for** the **2007 start-up**.
- **FMR** still not renovated and **delayed again.**
- **TT2 samplers unreliable**, but of major importance.

OASIS

- **The most important diagnostics system for the PS Complex.**
- Signal request statistics from 30 August 2006 onwards:
  - **Total:** 16025
  - PSB: 2552
  - PS: 6393
  - SPS: 1818



- Very difficult (premature) start
- New **functionalities** have been **added** and are **underway** (mountain range with burst trigger)

High level of support needed

"Passerelle" for GM and FESA

- The passerelle is **not** just **a minor tool** but is used widely and **should evolve** with all the changes (FESA) and get **full support**.
- **Failing to do this** will require the development of a **huge number of applications**.
- Some uses are: Archiving, fast trouble shooting, Settings comparison, Calculating new functions from acquired machine parameters, Machine development tool, etc….
- CTF3 and ISOLDE are also users of the Passerelle.

Equipment Renovation or Installation

- At start-up 2006 several newly installed equipment (TT2 quads cycling, SMH57 external condition) were badly working due to **wrong controls implementation**.
- In the past ***CO was doing the full implementation*** and discussed this with OP, now this has **shifted to the equipment groups**.

Good collaboration between equipment groups, CO and OP required for the correct operational use, proper naming, timing and interfacing.

Conclusions

- The list is not exhaustive and all additional issues are very welcome.
- Decentralizing the control system makes it less transparent and requires:
  - Improved hardware diagnostics tools
  - Clear view on responsibilities
  - Strong support needed from all parties
  - Piquet or Expert service ? (consequences ?)
- Renovating software means enhancing its performance and not loosing functionalities !
- Beam diagnostics is a key ingredient for good beam control and it should get more attention.

Efficient Tools and Good Collaboration are necessary to obtain required beam quality