Minutes of LHC-CP Link Meeting 28

Subject : LHC Controls Project

Date : 8th October, 2002

Place : 864-2-B14

Participating Groups :

LHC-ACR	aploogies,
LHC-ECR	no representative,
LHC-IAS	H.Milcent,
LHC-ICP	apologies
LHC-MMS	no representative,
LHC-MTA	no representative,
LHC-VAC	R. Gavaggio, I. Laugier,
PS-CO	B. Frammery,
SL-AP	no representative,
SL-BI	J-J Gras, L. Jensen,
SL-BT	E. Carlier, V. Mertens,
SL-CO	A. Bland, E. Hatziangeli,
SL-HRF	no representative,
SL-MR	R. Billen,
SL-MS	P. Dahlen,
SL-OP	M. Lamont,
SL-PO	no representative,
ST-MA	apologies.

Others : A. Daneels (Planning)
R. Lauckner (Chair),
B. Puccio, R. Schmidt (Machine Protection)
M. Tyrrell (Alarm Sub-Project),
M. Vanden Eynden (Core Team).

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Agenda :

1. Matters arising from Previous Meeting
2. LHC-CP News
3. Experience from the RF test stands — L. Arnaudon
4. QRL Baseline — A. Daneels
5. AOB

1. Matters arising from Previous Meeting

The more detailed report of QRL preparations would be scheduled for a future meeting

2. LHC-CP News

R. Lauckner pointed out that there had been a large increase in the meetings on controls in preparation for the creation of the new A&B division next year. The decision to merge the PS-CO, SL-CO and LHC-IAS groups means that it is necessary to re-focus the mandate of the LHC-CP which has now been put under the responsibility of the new A&B-CO group. The CP meetings will concentrate on the areas of new initiatives in controls, preparing systems for commissioning and operation and communication within the controls community. In parallel the CO Technical committee will track progess and examine resource issues of projects in the CO group. Nevertheless general status reports from these projects destined for a wider audience would be presented at the meetings.

Following this directions future topics are:

22nd October	New proposal for LHC Timing	J. Lewis
5th November	QRL Review	A. Daneels

3. Control room software for TT40 and TI8. M. Lamont

M. Lamont presented this topic on behalf of E. Hatziangeli and V. Paris. A new fast extraction system in LSS4 will be commissioned next year in preparation for future SPS beams for CNGS and the LHC Ring 2. A fast extraction kicker (MKE) and a thick magnetic septum (MSE) will deviate the extracted beam out of the SPS tunnel into TT40 where a short string of magnets will guide the beam onto an external dump during commissioning in 2003. In 2004 the beam will be taken to the downstream TI 8 dump: TED 8776.

In preparation for extraction and TT40 commissioning B. Goddard has initiated a series of meetings, the following aims are set for the MDs in 2003:

Verify equipment functionality
-Bumpers, MKE, MSE, BI, TT40 magnets, Interlock system
Extract beam from the SPS into the first part of TT40 onto TED:
-pilot beam
Verify trajectory and settings
Measure acceptance of extraction channel
Measure reproducibility of trajectory
Double batch extraction
Effect of MKE kicker ripple
Verify extraction interlock system?

Two MDs are scheduled for 8th September and 1st October in 2003.

A mixture of existing and new systems will be used. Magnets and Power Converters will require 12 new ROCS µgef channels that will be addressed from the existing SPS Ring software for the orbit bumpers and the TZ suite for the magnetic elements, dipoles, quadrupoles and steering elements, in TT40. In the extraction channel of LSS4, the kickers and the septa will be accessed via SPS2001 device servers and the device explorer in the control room.

All beam instrumentation will be controlled through BISCoTO crates, a possible exception are the Beam Loss monitors which will probably follow present SPS solution. BISCoTO will use the CMW as soon as it is ready, a prototype BISC0To server was delivered in April 2002 and BI is working to integrate it into servers and clients, but alternative access for Java and C clients is available today via the SL-EQUIP library. New BPMs will be interfaced to the TZ suite while applications for new BCTs and profile monitors will be developed in the SPS2001 frame. G. Crockford is working with the BI team to define the API properties to be implemented for application clients.

M. Lamont described the high level applications and which will be handled by existing applications (TZ) or new applications from the SPS 2001 project. In particular the kicker and septa settings will be integrated into a new coherent settings management by the SPS2001 team.

In addition to these specific solutions standard utilities will be required during the MDs. It is anticipated to use first versions of the LHC Logging and Post Mortem facilities to record measurements from beam and from equipment on a pulse-by-pulse basis. Definitions and responsibilities for software to acquire and forward the information are open subjects. M. Lamont pointed out that database keys must also be defined –a unique cycle ID would be useful but does not exist. The LHC-CP signals project has been asked to deliver a first remote digitising system with the necessary control room software for setting up the extraction timing for these MDs. Alarm facilities will be available from the current CERN Alarm System.

Software and hardware interlocks will eventually have to be upgraded. The tests in 2003 are planned with low intensity extracted beams as the Graphite diluter TPSG will probably not be ready to protect the septa. Neverthless the SPS Software Interlock System, SSIS, will be used to provide protection against certain equipment malfunctions. New operations modes are defined and “black boxes” to provide the SSIS with information from new equipment types must be developed.

The BI team pointed out that the SPS BST is already in use for the DABs crates being used to acquire some SPS position monitors at 10 Hz. BPMs will use the CMW if ready, otherwise an SL_EQUIP interface is available for MD purposes. JJ. Gras also mentioned that it may be possible to migrate the Beam Loss System to the BISCoTO.

R. Lauckner welcomed the possibility of testing the new LHC Logging and Post Mortem Systems with an SPS client. A. Bland wanted to know if timestamp would be required to key this information in the database. It was also mentioned that Cycle ID was not unique for the future CNGS neutrino extraction which has two independent extractions a few 10s of msecs apart. For this application an Extraction ID key would be unique.

M. Tyrrell asked if new surveillance software for the equipment was foreseen. R. Lauckner commented that it would be a retrograde step to write surveillance for the new equipment types in NODAL.

V. Mertens showed the planning for the TI8 installation and commissioning in 2004. It was noted that after these tests there would be no further opportunity for tests before CNGS start-up in 2006.

Outstanding Points

Alarm surveillance daemons

Logging and post mortem black boxes, interfaces, data keys

SSIS black boxes

Review of Controls installation and commissioning planning

Software commissioning schedule to be developed.

4. AOB

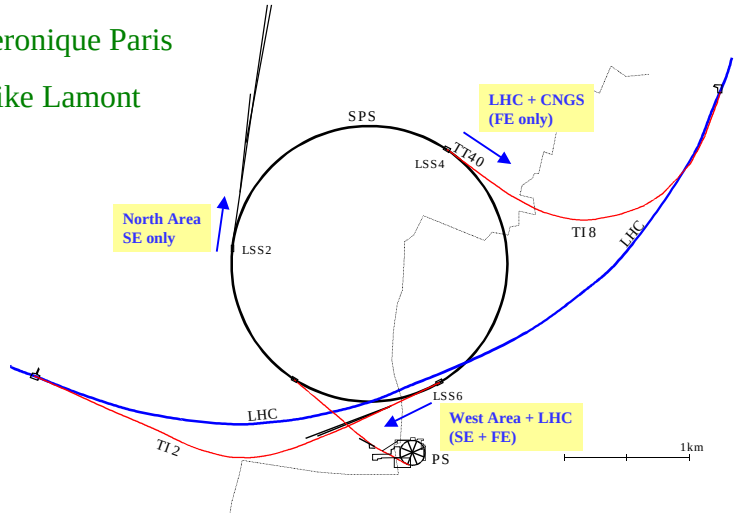
There was no further business.

Long-Term Actions	**People**
Common power circuit database requirements	R. Schmidt
Underground Control Rooms requested	R. Lauckner
Establish Post-mortem sub-project	R. Lauckner
Clarify Middleware Services to be used by LHC-CP	Core Team

Reported by R. Lauckner

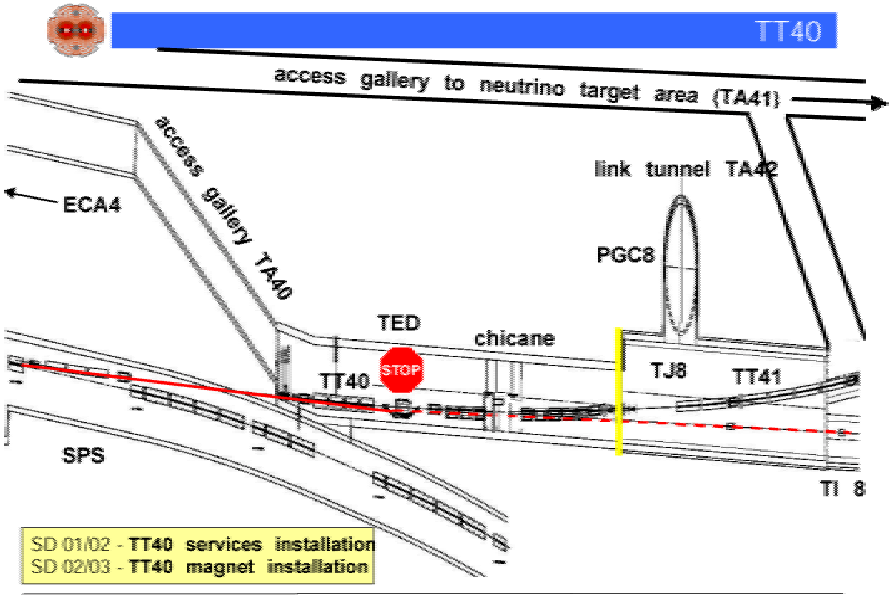
SPS Extraction Channels – Control Room Software

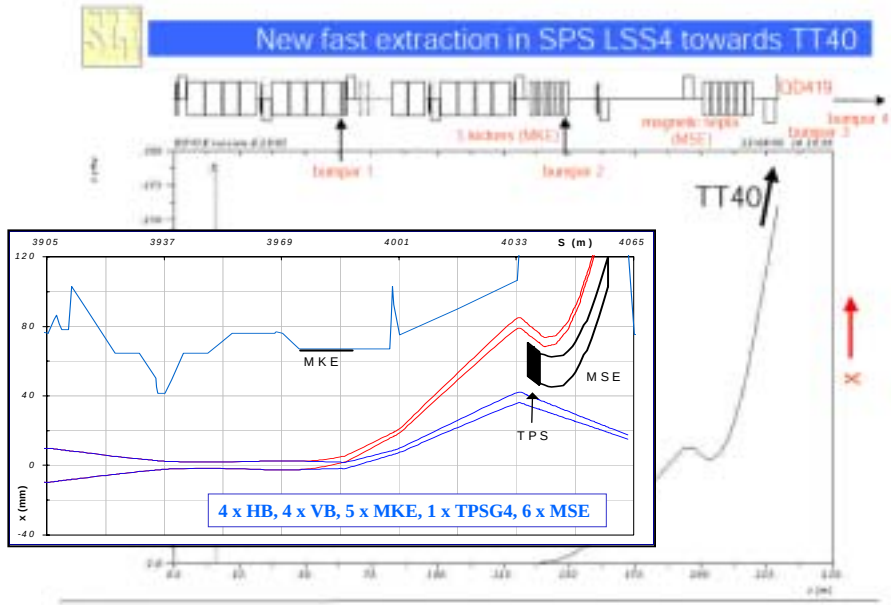
- Eugenia Hatziangeli
- Veronique Paris
- Mike Lamont



TI8

Construction is going ahead at full speed





2003 Extraction Test in LSS4

- **Verify equipment functionality**
  - **Bumpers, MKE, MSE, BI, TT40 magnets, Interlock system**
- **Extract beam from the SPS into the first part of TT40 onto TED:**
  - **pilot beam**
- **Verify trajectory and settings**
- **Measure acceptance of extraction channel**
- **Measure reproducibility of trajectory**
- **Double batch extraction**
- **Effect of MKE kicker ripple**
- ***Verify extraction interlock system?***

Scheduled to hold extraction tests with beam onto TED in second half 2003 – 2 days scheduled – 8/09 and 1/10 (27/10 in reserve)

Systems

- **Horizontal bumpers (414, 416, 420 & 422)**
  - **Used for extraction bump and orbit correction**
- **Vertical bumpers (413, 415, 421 & 423)**
  - **Used for +/-10mm orbit correction at high energy.**
- **Extraction kickers (0.5mrad total)**
  - **Modified version of existing MKE system**
- **Extraction Septa**
- **Power converters**
- **Magnets**
  - **surveillance**
- **Beam instrumentation**
  - **Beam loss monitors, position monitors, profile monitors, BCT**
- **Interlocks – slow & fast**
  - **Monitoring of beam position, losses, kicker states, bumper currents, MSE current, …, …**

Controls for extraction test (& TI8)

- **Equipment control**
  - **SPS2001 Device server**
  - **Middleware/SL-EQUIP**
  - **Timing**
- **Instrumentation**
  - **BST/TTC**
  - **Middleware**
- **Support systems**
  - **Logging**
  - **Post-mortem**
  - **NAOS**
  - **Alarms**
- **Interlocks**
- **Application software**

Focus on extraction test

Magnets/Power Converters

- **12 new ROCS µGef channels**
  - 4(H) + 4(V) bumper magnets in the SPS
  - MBHC (chain of 3 elements, 15 mrad total deflection)
  - MBHA (chain of 4 elements, 15 mrad total deflection)
  - 3 quads QTMD, QTLF, QTLD
  - 3 correctors (2xV, 1xH)

- **Bumpers by SPS main ring software**
- **New magnetic elements:**
  - **ROCS µGef under TZ control**

Kickers

- **MKE: 5 elements (up to 0.6 mrad total kick)**
  - **5 PFN's (beware of erratics!)**
  - **1 HT generator per extraction**
    - Two (3?) Extractions in case of CNGS
      timing: 1.1 µs rise & fall time (50 ms apart)
    - One extraction for LHC
  - **Protection (extraction inhibit):**
    - Compare the HT on the 5 PFN's just before the extraction with an independent reference based on MBI DCCT
  - **Extraction inhibit also available to external sources (dr. Interlock)**
  - **Timing – standard pre-pulses from RF**
  - **Verification of pre-pulse using NAOS**

- **Control via SPS2001 device server and device explorer**

Septa

- **1 TPS: graphite diluter (passive protection element)**
- **6 MSE: active elements (12 mrad total kick)**
  - **Girder position settings and measurement**
  - **Slow-control measurement and survey:**
    - Cooling (temperature, flow, pressure)
  - **6 ROCS µGef channels**
  - **Interlock source (current, position, cooling)**

- **Device Server provided by BT (SPS2001 compliant)**

Instrumentation

- **BPMs**
  - **1 large aperture (LSS4) to measure bumped beam position**
  - **4 (TT40) x 2 independent channels for LHC and CNGS beams**
  - **LHC type**
  - **Triggered by BST/TTC**
  - **BISCoTO using CMW if it's working.**
  - **Will require new black box to interface BPMs to TZ/SPS2001**
- **BLMs**
  - **13 beam loss monitors 7 (LSS4) + 6 (TT40)**
  - **For extraction test will probably following present SPS acquisition pathway. Standard SL-EQUIP…**
- **Fast BCT**
  - **Independent measurement of 72 LHC bunches plus integrated measurement for CNGS extraction**
  - **BISCoTO to CMW to SPS2001 application**

Instrumentation

- **5 profile monitors: 2 (LSS4) + 3 (TT40)**
  - **Set-up**
  - **Measurement of beam emittance**
  - **BISCoTO to CMW to SPS2001 applications**

Required data to be transfer to high level to be specified for all systems.

Applications

- **Line Steering (TZ)**
  - **Measure trajectories & correct**
    - Settings, trajectories
  - **Minimize excursions**
  - **Track drifts due to temperature, power converters**
- **Settings generation (TZ and SPS2001)**
- **Settings measurements (TZ measure)**
- **Magnetic elements - settings changes (TZ Drive)**
  - **Protection against bad manipulations - sanity checks to be implemented.**
- **Kicker and septa settings integrated into a coherent settings management (SPS2001)**

Standard Utilities: Logging

- **Will use LHC prototype database to log the following:**
- **Shot by shot (hence Post Mortem also):**
  - **Beam losses**
  - **Beam positions**
  - **Beam sizes from screens**
  - **SEM grids before 1st TED**
  - **BCT – intensities on dump and in ring [INB requirement]**
  - **Power converters - current waveform**
  - **Bumper magnets - current waveform**
  - **MKE kickers - voltage, timing, fault states**
  - **MSE septum - current waveform, girder positions, coil + yoke temperatures, fault states**
  - **Machine protection**

Automatic acquisition required

Ideally this will all be acquired in a uniform way and stored somewhere with a unique cycle ID to make analysis easy.

NAOS

- **Old VXI replaced with new low level system – speedy Pentium wizzy stuff – sure to be done**
- **For BT one crate will be installed for Etienne.**
- **The protocol for communication would probably remain the same.**
- **The Motif based applications could stay the same.**
- **The software that runs on VXI is POSIX compliant and porting is not a big problem.**

⇒ NAOS well under control

Surveillance & Interlocks

- **Alarms – existing system**
- **Surveillance**
  - Vital Data : injection kicker, dump system, power supplies
  - Monitor technical services : vacuum, temperature
- **Software and Hardware Interlocks will have eventually be upgraded**
  - **Cycle dependent**
  - **Disable SPS extraction and dump beam in SPS or**
  - **Don't fire injection kicker and put beam on TDI (LHC injection inhibit)**
  - **Sources includes:**
    - Large aperture BPM, measured bumped beam position will feed the extraction interlock
    - SPS beam loss monitors
    - TT40 beam loss monitors into SSIS
    - Possibility to inhibit next cycle if losses are excessive
    - Profile screens: possible LHC injection interlock
    - Bumper magnets in SPS and dipole chains in TT40 (beam dump and/or extraction veto)
    - Etc…

Interlocks

- **But in the meantime, software interlocks…**
- **Take the existing SSIS system and**
  - **Add new modes to BEAMST, and MACHST (LSS4, CNGS)**
  - **New elementary tests to be written to take in the new modes covering the new lines**
  - **New black boxes for SSIS measurements should be written for new equipment types, or new members added to existing measurement types.**

This should cover fast extraction interlocks with LHC beam and is already being addressed.

Hardware interlocks are someone else's problem…

Conclusions

- **Equipment**
  - **Beam Transfer equipment will be handled by SPS-2001**
  - **Power converters by TZ**
- **Instrumentation**
  - **BCT: SPS2001**
  - **BPMs: SPS2001 but to be passed to TZ**
  - **Profile monitors: SPS2001**
  - **BLMs: extend existing SPS software**
- **Applications**
  - **Steering, power converter measurement, control of magnetic elements: TZ**
  - **BT extraction elements: SPS2001**
- **Support services**
  - **Logging: LHC prototype**
  - **NAOS: OK**
- **Interlocks – there is a solution**

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the Large Hadron Collider project

LHC Project Document No.
LHC-TI8-MS-0001 rev. 1.1
CERN Div./Group or Supplier/Contractor Document No.
AC/TCP & SL/BT
EDMS Document No.
323089

LHC Project

TI8 Transfer Line Installation & Commissioning

Date : 2002-10-08