

## SECTOR TEST – PREPARATION

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### *Abstract*

### INTRODUCTION

This session of the 15<sup>th</sup> Chamonix Workshop was devoted to the definition of the required hardware and its availability for the sector test. Planning aspects for both the components and the hardware commissioning were also presented.

### PLANNING

E. Barbero Soto presented the detailed planning from the installation of the continuous cryostat to the hardware commissioning that has to be followed to inject beam through sector 7-8 at the end of 2006. She summarised the required hardware, recalling that the helium distribution line (QRL) cannot be sectorised. The implication of the latter is that all components for the helium distribution line (in particular the electrical feed-boxes, DFBs) must be available not later than May or June 2006, if both sectors are partially commissioned. Even so, the available time for hardware commissioning is critical and any delay may compromise the quality of the testing work. It clearly came out in the discussion that one should not compromise on the proper hardware tests. Thus all components for the helium distribution line must be available no later than April in sector 7-8, and May for sector 8-1. It was also mentioned that the planning did not take into consideration the actual failure rates on interconnects, evaluated to 3 % from industrial data, also confirmed by the experience with the QRL.

As transport is blocked in the area of the temporary dump in LSS 7 for 5 weeks, there is also an impact on the progress of the installation in sector 6-7. Studies are going on to use UX65 as a temporary storage for short straight sections and having main dipoles transported from the other side. Alignment work downstream LSS7, as well as installation of room temperature components (e.g. collimators) will also be affected. The closure of TI8 for 6 weeks does not impact on the LHC activities.

### GLOBAL HARDWARE STATUS

M. Jimenez presented the state of the layout and summarised the known availability of all major components. He emphasised that the configuration for the sector test must be the final LHC one, except for LSS7. The integration activity is well advanced and should be completed before May with the last part of TI8 and IR8R. However, there still are a number of difficulties to solve in the area where the beam joins the LHC tunnel coming out of TI8. Lack of space is the main issue in this context. As a general point for the integration activity, it is now absolutely mandatory to

freeze the layout so as to be able to complete the 3D mock-up and produce the installation drawings.

As for the availability of the components, M. Jimenez showed a list of equipment to be closely followed-up, like some beam instrumentation equipment or the vacuum chambers and pumping ports for the septum. As identified earlier, the DFBs are on the critical path, but also some of the collimation equipment for which the design is completed but the manufacturing only starts now.

### LAYOUT IN LSS7

J. Uythoven presented the layout of LSS7, where a temporary dump block as well as some shielding have to be installed downstream of Q6. The latter and its electrical feed-box (DFBM) have to be installed to complete the helium distribution line. The location of the dump block is chosen to be far enough from the helium distribution return module to avoid potential radiation problems. The dump block is “borrowed” from TI2, to avoid importing already irradiated materials into the LHC tunnel.

The final elements downstream of Q6 will be replaced by a 29 metre long vacuum pipe, made out of standard vacuum chambers and components. No collimators will be installed, only one beam current transformer is required between Q6 and the dump block. The base line beam loss monitors should be installed, no additional ones are required.

Removing the dump block and the temporary vacuum chamber will be the only additional work before continuing with the installation after the sector test.

### HARDWARE COMMISSIONING

R. Saban presented the hardware commissioning scenario, summarising the state of commissioning the various components must have before beam can be injected. The discussion focussed on the tests required for the superconducting magnet circuits. The allocated time and resources will make it nearly impossible to do a complete commissioning. There was a large consensus, however, that it will not be acceptable to put equipment at risk as a consequence of a partial hardware commissioning sequence. Even though only some 20% of the nominal current is required for the test, this level is high enough to provoke severe damages in the case the quench protection system would not have been fully debugged. A partial hardware commissioning is also likely to be more demanding on resources.

## STATE OF LHCb FOR THE SECTOR TEST

M. Ferroluzzi described the LHCb experiment, in particular the minimum to be installed for the sector test. This includes the Vertex Locator (VELO) tank, although with blanks instead of the detector modules, and the complete vacuum chamber. He also presented an “agreement” between LHCb and the accelerator in order to minimise the perturbations the sector test would induce on the completion of the LHCb experiment, in particular in matters of radiation aspects. LHCb expects that the installation activity will not be affected after the sector test by radiation problems. He also showed that the overall LHCb planning integrates the sector test.

### RADIATION ISSUES

H. Vincke presented two facets of the radiation aspects linked with the sector test. The first part covers the status of the area downstream TI8 after the high intensity injection test foreseen in October 2006. Intensities up to  $4 \cdot 10^{14}$  protons will have to be absorbed by the dump block (TED). Copper samples will be placed in the R88 gallery and the UJ88 junction region to witness the possible activation of the already installed LHC equipment. FLUKA calculations have been conducted to predict the dose rates due to prompt radiation (during the test), the dose rates after test, the activation of material and the activation of TED cooling water. Dose rates in the  $50 \mu\text{Sv/h}$  range must be expected downstream of the dump after one hour of cooling time, decreasing to  $0.1 \mu\text{Sv/h}$  after one week. Materials in the LHC tunnel will very likely become activated, hence the zone will become a supervised area (personnel dosimeter mandatory) and all material must be controlled before being removed from the area. The cooling water of the dump block will be activated, but can be considered as non-radioactive.

For the sector test, the requirements are that the sector should be reclassified to non-designated area and that there must be no radiological consequences for LHCb. Again, FLUKA calculations are used to predict the dose rates and potential activation of materials. During the test, access must be prohibited in the area 1 km downstream of the dump in LSS7, access in the LHCb service area behind shielding wall will only be permitted in case access to the detector area is prevented (access doors). The temporary dump can (and should) be removed 4 or 5 days after the end of the run. Before re-

classification, a thorough radiation survey will have to be performed in the dump zone. For the LHCb experiment, it will be extremely important to minimise any beam losses in the area and to move the detector parts as far away as possible from the beam pipe. Here also, a thorough radiation survey is needed after the test and samples will be placed at adequate locations to assess the potential activation of materials.

### TEMPORARY ACCESS SYSTEM

P. Ninin reported on the foreseen temporary access system required for the sector test. In order to protect personnel against radiation hazard during the tests, access to underground areas around Points 8 and 7 (and the arc in between) must be fully operational during the test. Access doors must be interlocked to disable beam in a failsafe way if safety conditions are violated. Temporary interlocked gates will be installed in sectors 8-1 and 7-6. The machine access gates in point 7 and 8 must be fully operational. The interlock chain to inject from TI8 must also be operational. As the new access system relies on biometric identification, good preparation of enrolment and authorisations must start promptly.

The sector test is, however, considered as an excellent opportunity to validate the equipment and procedures (e.g. the patrol before closing the tunnel).

### SUMMARY

Based on our present knowledge of availability of components, the sector test is still a reachable objective. However, so far, little experience has been gathered with the interconnection work of the magnets, a very complex activity. Also some components (electrical feed-boxes and collimators in particular) are on the critical path from the manufacturing point of view.

There is a consensus that no compromise should be done during the system tests and the hardware commissioning which could put all or part of the cryogenic magnets at risk. Also, no temporary solutions should be implemented, but rather aim at installing according to the layout for first colliding beams.

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