# Meeting on Status of Collimation Insertions and Element Positioning in IR3/7

(6.12.2002)

***Attendees:***

| | |
|---|---|
| R. Assmann (chairman) | SL/AP |
| M. Brugger | TIS/RP |
| L. Bruno | SL/BT |
| E. Chiaveri | SL/DI |
| B. Dehning | SL/BI |
| O. Hans | SL/MS |
| C. Hauviller | LHC/CRI |
| J. Guillaume | ST/EL |
| B. Jeanneret | SL/AP |
| S. Myers | SL/DI |
| G. Peon | ST/CV |
| D. Perrin | TIS/RP |
| Ch. Pignard | SL/CO |
| P. Proudlock | AC/TCP |
| R. Rausch | SL/CO |
| G. de Rijk | SL/MS |
| J.P. Riunaud | PS/AE |
| S. Roesler | TIS/RP |
| R. Schmidt | AC/TCP |
| P. Sievers | LHC/MTA |
| G.R. Stevenson | TIS/RP |
| P. Strubin | LHC/VAC |
| T. Wijnands | SL/CO |

***Minutes:***

The meeting was called to discuss the status of the collimation system design and the consequences for the schedule of LHC installation in the warm parts of IR3 and IR7. This became urgent as IR7 installation was foreseen to start in February 2003.

### 1. Introductory remarks

*Steve Myers* opened the meeting and introduced the new organization of the collimation work. He explained that the collimation system is a very important part of the LHC and it touches a variety of issues in different divisions and groups. The work on this system is on the critical path and a project has now been set up to coordinate the work and ensure completion in time for LHC start-up. Ralph Assmann has been appointed Project Leader. The new AB/ATB group will have a section on targets, dumps, and collimators that is responsible for building the collimators. Steve introduced the mandate of the LHC Collimation Project (available at http://www.cern.ch/lhc-collimation-project) and asked the attendees for their support of this difficult activity.

## 2. Status of collimator work and consequences for schedule of LHC installation

*Ralph Assmann* gave an overview of the challenges for LHC collimation and the work ahead (see slides at http://www.cern.ch/lhc-collimation/library_talks.htm ):

1. As well known, the transverse energy density in the LHC beam is about a factor of 1000 above previously achieved. At less than 1 % of its nominal intensity, LHC will enter new territory.
2. **The present design of the collimation system (as implemented in optics V6.4) is not adequate.** The presently implemented Copper jaws could only withstand $2 \times 10^{-5}$ of the total intensity, about 400 times less than required for specific dump failures (expected to happen at least once per year).
3. The LHC collimation system must not only be robust but at the same time respect tolerances on the 10 micron level.
4. **A new collimation system is under design for the nominal LHC, involving low Z materials and longer jaws.** Present estimates show that a single jaw can increase from 0.5 m to about 1.2 m (including tapering). Alternative solutions ("repairable" collimators, system with ultimate robustness) are also under study.
5. A first educated guess shows that low Z jaws could cause changes in element positioning of up to 2 m. As the optics must be maintained symmetric, elements will move even at locations where there is no collimator.
6. Definitive answers can only be given after the design has been finalized (engineering requirements might take additional space).
7. **Additional collimators might be required for machine protection reasons.** Areas that are now "clean" can therefore become exposed to radiation in the final design.
8. **The cables for the collimation system have neither been specified nor ordered.** A second campaign of installing cables is anyway needed.

Ralph Assmann presented two options for IR3 and IR7:

1. A **proper and careful design** of an optimized collimation system for the LHC. In an optimistic scenario this would allow us to have prototype collimators and an advanced new layout for IR3/IR7 by the end of 2003/beginning of 2004. 66 collimator tanks would be produced in 2004/05 and installed in 2006. This is the proposed solution.
2. A **placeholder optics** is designed for IR3/IR7 which provides enough space for foreseeable collimator solutions (e.g. provide 3 m space for each collimator tank). This would allow freezing the insertions between March and June, however, with the cost of reduced collimation performance.

This presentation was followed by an extensive and constructive discussion. The attendees recognized the difficulties connected to the LHC collimation system. The option to have a fast but sub-optimal solution was not supported. **A proper and careful design (option 1) was strongly favored, even though it is incompatible with the present LHC installation schedule.**

*Claude Hauviller* stated that it could be possible to delay installation in the warm parts of IR3/IR7 until 2005 or 2006 **without delaying the LHC project** (subject to a detailed review of schedule). *J.C. Guillaume* stated that there will be some additional cost due to a later installation campaign,

however, this should be small if all cabling/installation in the warm parts of IR3/IR7 are grouped. An issue remains with the sector test, namely whether beam will be allowed into one or two sectors. *G. Stevenson* stated that any beam operation would require full installation of the concerned machine parts, as the area becomes a radiation zone afterwards. **The proposed installation of collimators in 2006 would only be compatible with a single sector test with beam.**

**Other action items** were brought up during or after the meeting:

- **The design of the 12 TCL-type collimators (located in points 1, 2, 5, and 8) has not been done.** P. Strubin stressed that their design must be decided soon in order to finalize the hardware layout at these locations. R. Assmann commented that it must be determined when these collimators are required (start-up or only high luminosity running). The design should be less difficult (Cu is OK) but must be started.
- **Additional longitudinal space might be taken by the heat exchangers, which are required for the separate cooling circuits on the collimators.** Each exchange station could take 1 m with further details to be worked out during the detailed design. Contact person is G. Peon.
- **Additional dipole correctors might be required to have one corrector per plane at each warm quadrupole in IR3/IR7.** This coverage might be mandatory in order to achieve the required orbit stability in IR3/IR7, especially in view of a change in magnetic quadrupole axis, which is expected. These correctors are several m's long and must be "ordered" essentially now. Contact person is G. de Rijk or his successor.
- **Space reservations should be done urgently for downstream racks required for collimation.**

### 3. Radiation issues related to the collimators

*M. Brugger* summarized the expected radiation levels due to beam loss in the cleaning insertion IR7 (see slides at http://www.cern.ch/lhc-collimation/library_talks.htm). This is important for the positioning of several equipments (e.g. monitors of induced activity, BLM's, sensitive vacuum equipment, …) as they must be located in areas with either maximum or minimum activity. Early results are based on preliminary assumptions on the new collimators. In particular he compared the dose rates to the maximum level that does not require remote handling (20 mSv/h). **The collimators and some parts up to 12 m downstream (beam pipe) would be highly restricted areas with dose rates above 2 mSv/h.** Maintenance of this equipment will be a major source of personnel exposure to radiation. G. Stevenson stated that the preliminary numbers, however, indicate that **full remote handling can be avoided**. A final survey of dose rates in the cleaning insertions will only be possible once the collimator design has been decided and the cleaning insertions have been re-matched for the final layout. Studies are nevertheless ongoing in TIS/RP and at IHEP.

**Other action items** were brought up during or after the meeting:

- G. de Rijk noted that the orientation of the magnets in IR3/IR7 should be optimized in order to achieve maximum reliability of the magnets (make use of asymmetry in radiation impact). This is of particular importance, as only four spares are available for the warm quadrupoles. Contact is G. Mugnai.