Stefano Redaelli, 07-01-2008

91st Meeting of the LHC Collimation Working Group, December 13th, 2007

Present: Ralph Assmann (chairman), Etienne Carlier, Brennan Goddard, Michel Jonker, Alessandro Masi, Stefano Redaelli (scientific secretary), Rüdiger Schmidt.

1 Integration of TCDQ into collimator software and TCDQ interlocking strategy

1.1 Introduction

This special meeting of the LHC collimation working group was held to discuss the following issues related to the TCDQ controls:

- Integration of position controls (settings and readout) into the collimator control software;
- Synchronization with the other collimators in the ring;
- Interlocking strategy;
- Temperature display and temperature threshold control.

The TCDQ diluter control requirements are similar to the other collimator in the ring however these devices use a different low-level control system. The single, 6 m jaw of the TCDQ will be moved by two DC motors, driven in a servo-loop using position measurements from potentiometers. The system was presented in detail at the COCOST meeting of March 9th, 2007:
http://controls-wiki.web.cern.ch/controls-wiki/collimators/COCOSTminutes/20070309
A note on the control requirements for the TCDQ has recently been circulated for approval and can be consulted in EDMS: LHC-TCD-ES-0001.

1.2 Integration of TCDQ position controls into the collimator software

It was agreed that the controls of the TCDQ positioning (settings and measurement readout) will be done with the collimator application. Etienne Carlier will provide a FESA class that duplicates the CSSInterface class properties used for the other collimators. This will minimise the impact on the collimator application because the top-level will send the settings in the same format used for the other collimators. The TCDQ FESA class will also provide the same structure of the readout properties used for the jaw survey (with zeros in the field that are empty for the TCDQ that has only one jaw). Position settings, threshold values and position readout will be expressed beam coordinate system as defined in the specs LHC-TCT-ES-0001-10-00. The collimation team will provide to Etienne a detailed description of the collimator class properties.

S. Redaelli commented that in the TCDQ specs it is stated that the functions for the TCDQ control are limited to 64 points. This seems too little for a precise control. Is this an hard limit or can it be increased (the limit is 1000 points for the other collimators). B. Goddard commented that the TCDQ is not an high precision device and it will be controlled with an accuracy of 100 μm. Therefore, 64 points were estimated to be sufficient even for slow movements like the ones required during the energy ramp. On the other hand,

this is not an hard limit and the number of points can be increased if necessary. R. Assmann suggested to increase this number because it seems too small.

Michel Jonker commented that in the TCDQ controls specs it is stated that the maximum length of position functions is about 350 seconds. Longer movements are not possible due to overheating of the motor clutch. Brennan agreed that this aspect should be sorted out. Etienne commented that this will pose no limits to the execution of long functions. Details will be discussed outside of the meeting.

1.3 Synchronization issues

The is not a direct synchronization of the TCDQ with the other collimators. B. Goddard reminded that the drive of the pre-defined TCDQ position functions will be triggered by the machine timing, as it is done for all the other collimators. This will ensure a synchronous motion of the TCDQ with all the other collimators (not because it is directly synchronized with the other collimators but because all the devices will be synchronized to the same machine timing).

1.4 Temperature display and temperature threshold control

S. Redaelli pointed out that the collimator application only contains a display of the collimator temperature (5 sensors per collimator measure the temperature of the 4 jaw corners and of the cooling water). The definition of temperature thresholds (warning and dump levels) will be taken care of by the CO team of P. Gayet. The temperature controls are based on PLC whose control software has been prepared within the UNYCOS framework (J. Brahy and E. Blanco Vinuela). A first version was deployed for the this year's transfer line test. The software allows displaying the temperature and also to set temperature thresholds. The strategy for the interlocked values has to be agreed upon. The temperature signals will be HW interlocked. R. Assmann believes that the same approach should be used for the TCDQ.

The display of the TCDQ temperature reading will be possible within the collimator software provided that the temperature readout will be exposed at the FESA level. However, the definition of warning and dump thresholds must rely on a separate application. Stefano suggested that the TCDQ could also be managed like the other collimators but Etienne replied that this is not possible because the PLC's used for the TCDQ are not compatible with the UNYCOS system. If we cannot sort this out, a dedicated application should be prepared by BT for setting the temperature thresholds.

1.5 Interlocking strategy

R. Assmann reminded everybody that due to the available manpower in ATB it had been accepted that the low level controls of the TCDQ is implemented with a dedicated PLC solution by BT for the LHC startup.

R. Assmann stressed also that in various discussions it was requested that on the long term the TCDQ controls should implement the same position interlocking strategy as all the other collimators: the interlock should be based on the precise reading of LVDT signals and compared with dump functions defined at the top level. For this purpose two LVDT's were mounted on each TCDQ.

R. Assmann and R. Schmidt think that the best solution on the long term would be to integrate the LVDT's of the TCDQ in the low-level collimator controls in order to get an homogeneous system. B. Goddard and E. Carlier agreed. M. Jonker agrees as well and commented that the implementation of the survey of few more sensors should not be big deal. A. Masi pointed out that from the technical point of view it is not at all straightforward to include additional isolated LVDT survey units in the low-level collimator controls. A

dedicated software would need to be deployed, which is different than the one of the other collimators: the collimator software manages two PXI units for motor driver control and position survey whereas the TCDQ system has only the position survey unit. Basically, the same amount of work would be needed as if Etienne's team took care of the LVDT sensors. In fact this should be the baseline solution because the TCDQ interlocking is under the responsibility of BT. ATB cannot take the responsibility of all the LVDT's in the LHC. For example, the colleagues from TOTEM will adopt the collimator low-level controls for the Roman pots however they will keep the full responsibility of their system.

R. Assmann , M. Jonker, R. Schmidt and B. Goddard proposed that this issue should be followed up by R. Schmidt within the scope of machine protection. If we cannot find an agreement, we should get from the parties involved an assessment of the required manpower for the two possible solutions (ATB team taking over the LVDT-based TCDQ interlock or BT team implementing the LVDT readout and BIC connection). Then, the two options should be presented at the LTC for the final decision. R. Schmidt stressed that from our side we should provide a recommendation based only on technical arguments.

R. Assmann commented that the collimators low-level will also implement a redundant interlock of jaw positions and collimator gaps based on functions of energy and beta*. If the TCDQ adopted the same survey unit as the other collimators, this feature could also be ensured. A. Masi warned that this would not be achieved for free: a dedicated software would need to be prepared. The same logic for the energy based interlock can also be implemented in the present PLC-based controls.

The next meeting will be announced.

Follow-up after the meeting

Roberto Losito sent the following comments to the draft minutes circulated for comments by Stefano Redaelli. Roberto Losito reminded everybody that the TCDQ is an equipment under the full responsibility of BT. ATB has never foreseen, and will not foresee any manpower for the TCDQ in the future. BT should study and propose the best technical solution based on its available resources and then afford the development, commissioning and exploitation of the system without relying on ATB.
R. Losito reminded as well that apart from the argument of responsibility of the system, there are technical reasons of concern about the correct use of LVDTs and of the PXI system for the TCDQ. In order to be compatible with the collimator controls, the whole system should have been designed for it. As an example, in order to use the same concept for the TDI, ATB took the decision to replace DC motors with stepping motors (no more servo loops), and modify the mechanics in order to allow a remote calibration of the sensors. These modifications should probably be foreseen as well on the TCDQ if BT really intends to use the collimator controls.
R. Losito warns everybody that the accuracy achievable at present by the collimators controls applied to the present TCDQ system cannot be better than the accuracy of the potentiometers. Due to the concept of conditioning used by the collimator controls, the calibration of the LVDTs shall have to be verified regularly (every year?) and with the present status of the mechanics this can only be done with reference to the potentiometers. This means that

1) the two measurements shall not be independent
2) the LVDTs accuracy will be worst or, in the most optimistic case, identical to that of the potentiometers.

ATB is of course willing to provide advice on the subject, but with the present status, cannot accept any responsibility with the TCDQ.