## Minutes of the 16th meeting of the SPS Upgrade Study Team on 11 July 2008

**Present:** G. Arduini, M. Barnes, F. Caspers, R. Garoby, Y. Kadi, R. Losito, E. Shaposhnikova, M. Taborelli, C. Yin Vallgren, J. Uythoven

**Excused:** S. Calatroni, J.M. Jiminez, E. Metral, G. Rumolo

- **TIDVG - Y. Kadi**

The presentation was mainly devoted to the analysis and proposed solutions to minimise present pressure rises at the TIDVG (Target Internal Dump Vertical Graphite) induced by repetitive dumping during MDs in the SPS. The TIDVG is one of 4 beam dumps/collimators installed in LSS1. It serves to absorb all types of the SPS beam dumped with energy above 105 GeV/c. Below 37 GeV/c beam is dumped at the TIDH. No dumping is possible between these two limits. The beam deposition pattern is fixed. In a design made in 2000 for high intensity beams, the Aluminum core (primary dump) was replaced by Graphite and the cooling system was modified. The Graphite was covered by Titanium foil which was damaged during operation and became an SPS aperture limitation. Due to the high radioactivity the repair was not possible and the dump was replaced in 2006 by one of the two spares produced in 2000. This time the Graphite was baked to 1000 deg before coating and to 150 deg in situ (250 deg was recommended but could not be achieved due to limitation of the bake-out system). From 2006 dumping of the LHC beam during MDs causes significant pressure rises and beam interlocks, in particular the one protecting the MKP. This is explained by the fact that operational temperatures (T) are higher than the final bake-out T (150 deg). The pressure rise could also be aggravated by the presence of e-cloud.

Simulations performed for a heat deposition show that the maximum T inside Graphite is 160 deg for nominal LHC beam intensity with 7.8 $\mu s$ sweep time and can reach 180 deg steady state with 240 deg peak for 21.6 s long LHC cycles. The maximum T in Tungsten (which was not baked-out at all) are significantly lower. The LHC beam is more critical due to smaller time to sweep the beam in comparison with CNGS beam which fills a whole ring.

The external solutions to the problem that were reviewed include reduced gas conductivity, increased pumping power with NEG option and relocation of the whole dumping system. Two other options, called "internal", are

(I) Significant improvements of the last spare dump - TIDVG #3 (money already allocated from consolidation, however problem with manpower) followed in future by a new design for the SPS upgrade.

(II) Leaving the existing spare untouched and building a new dumping system which will satisfy all requirements for the SPS upgrade.

The choice between these two internal options can be made when the limitations of modified spare in option I for future beams (SPS upgrade) have been estimated. Taking into account the time scale needed for the internal options, an increased pumping speed could be a promising short term solution. Different possibilities for graphite coatings exist and should also be studied.

- **Present status and future plans for the MKD beam dump kickers - M. Barnes**

Two MKDV and three MKDH kicker magnets, also installed in LSS1, provide vertical and horizontal beam deflection and sweep for optimum energy distribution over the absorber blocks. The MKDV kickers (5 sections) are made from ferrite and their kick rise time is 1 $\mu s$. The MKDH (1 section, total magnet length half that of MKDV) are made from laminated steel (0.35 mm thick) and their kick rise time is 23 $\mu s$. All these kickers are 30 years old and they do not have any impedance-reduction modifications (including transition pieces between kicker and vacuum tank).

The measured impedance of MKDV seems to be below (by a factor $\sim 4$) those of the MKE with serigraphy, however, according to Fritz, transition pieces were not used in measurements so in reality the impedance of the structure which includes the vacuum tank could be higher.

Future plans include rearrangement of MKDV PFNs (Pulse Forming Network) to increase the system reliability (failure of one magnet now has impact on the field in the second). More impedance measurements and estimations for both MKDV and MKDH are required to take a decision about their shielding. The transition pieces between magnet and tank are desirable in all cases.

With PS2 in operation the structure of the FT/CNGS beam in the SPS will be different, with 1.7 $\mu s$ beam gap available for kick rise-time (assuming 1.1 $\mu s$ beam gap needed in the PS2 and PS2/SPS ratio of 15/77). For injection at 50 GeV a dynamic range of 9 (or even 18 for 25 GeV) will be required ($450/105 = 4.3$ at present) motivating the development of a (fast) semiconductor switch for MKDV.

**The results from the SPS long MD - C. Yin Villgren**

The measurements taken with three LHC batches at nominal intensity during 8 hours of the SPS long MD in week 28 using the SEMcloud monitors for Stainless Steel (SS), NEG and Carbon (C) samples were presented. They show the scrubbing effect for SS and a very low signal from C sample (below NEG level). Only a few nA current was measured for the activated NEG and this C coating in comparison to $\sim 2.55 \times 10^4$ nA for SS and $\sim 0.5 \times 10^4$ nA for the previous C coating at the end of the scrubbing run. Note that the initial SEY is believed to be 2.5 for SS, below 1 for C and 1.1 for activated NEG (1.3 for non-activated).

- The next meeting will be on **5 August 2008** at 15:30 in the JBA room (bld. 864).

Agenda:

Transverse feedback to cure electron-cloud induced single-bunch vertical instability - W. Hofle

Progress report on coatings and grooves - M. Taborelli

Elena Shaposhnikova, 14.07.2008