HL-LHC Technical Coordination Committee Preparation Meeting – 26/06/2020

Participants: A. Apollonio, O. Brüning (chair), F. Cerutti, F.-X. Nuiry, M. Sabate Gilarte, D. Schoerling, M. Sisti, R. Van Weelderen, M. Zerlauth.

The slides of all presentations can be found on the following Indico page.

As an introduction to a later discussion and final decision in a TCC, this preparation meeting is a follow-up of the actions identified during the 88th HL-LHC TCC meeting. At the time, potential issues related to the lifetime of MCBC/Y correctors with HL-LHC luminosities were highlighted. Several options to cope with the increased accumulated dose were proposed, including the possibility to rotate the Q4 magnets.
Several points were required to be followed-up:

1. Update on the dose limits for the magnets following a dedicated radiation test campaign
2. Update of the estimates of the accumulated dose in the magnets, depending on realistic assumptions of operating conditions post LS3
3. Update on implications on the cryogenic system

D. Schoerling reminded the participants about the assumed limit of 5 MGy radiation hardness, which still remains to be demonstrated with the gamma irradiation campaign (expected in March 2020, but delayed due to the Covid-19 restrictions). He provided an update on the various tests which are planned. Results are expected in about three months.
The question of the impact of losses beyond Q4 was discussed. F. Cerutti pointed out that no problems are expected in Cell 10, but in Cell 11 (and eventually Cell 13) losses might be more significant again, so this still needs to be checked.

M. Sabate Gilarte provided an update on the dose rate estimations for the Q4 magnet, based on latest luminosity estimates and operational scenarios, summarized in the table below. The reported values are valid for Run4 only (one would have to add ~0.2MGy of accumulated dose in these magnets until LS3).

Horizontal Crossing		baseline	Q4-assembly rotated
250 μrad		1.1	0.7
190 μrad		1.0	0.6
Vertical Crossing			
250 μrad	up	2.4	0.6
	up/down	1.2	0.4
190 μrad	up	1.8	
	up/down	1.0	

Dose in MGy

Run 4
561.3* fb^{-1}

Primarily due to the reduction in the accumulated luminosity during Run4 (due to the intensity ramp-up), the accumulated dose in the MCBY magnets of the Q4 assembly is reduced to a maximum of 1.5 MGy for the whole range of Xing angles of the baseline scenario, assuming however as well a polarity mix for the crossing angle.
Concerning the polarity change, F. Cerutti mentioned this should not be a problem operationally, but it's worth checking with WP2 and CMS to be sure.
ACTION: F. Cerutti should check with WP2 the feasibility of the polarity change for HL-LHC operation.
The Q4 rotation, although advantageous, was not yet approved, as it implies additional work and might not be necessary. R. Van Weelderen stated that for WP9 there's anyways some work to be done for the re-connection of the Q4 following the move due to the crab-cavity introduction, so the overhead would be relatively small for the rotation.

M. Sabate Gilarte explained that when replacing the MCBC in the DS by a MCBY, the gap between 56 and 70 mm in diameter could be filled with inermet in order to protect the coils. The heat load in this inermet layer, in the most exposed region of the DS (Half-Cell 9), is estimated to be ~1 W for ultimate operation. The possibility to absorb this load has to be confirmed by CRG colleagues. On the MCBY tungsten insert the 1 W would be concentrated on the front face. The exact calculation has not yet been done as the above estimates are based on existing simulations from MCBC, but this could be done in more detail by WP10 in the coming months. The losses will be in the horizontal plane and on the inner side of the magnet and concentrated at the beginning of the magnet. Calculating the load on the tungsten by the end of July would be a considerable effort for WP10, so M. Zerlauth suggested to wait for the irradiation results and keep 1 W as a reference for the moment. R. Val Weelderen stated that this heat load can be absorbed without major problems by the current cryogenic system, in case it should be a minor effort to foresee small additional cooling channels in the inermet shielding at the appropriate locations. Shielding would be done in the pressurized volume. There would be no need to fundamentally change the MCBY design.

M. Sisti reported on the impact on the cryogenic system. The concept for the QRL for Q4 has been developed, going from two separated Service Modules to one new double-jumper SM due to length limitation. WP9 will adapt to any solution decided for QRL Service Module. Important inputs are depending on WP3 & WP6a. The Q4 rotation would induce however considerable rework of Q4 extremities, as well as DSLE Q4-Q5 area.

M. Zerlauth proposed to have an update discussion at the end of July in the TCC, focusing on the new radiation estimates and a complete update with results of the irradiation campaign + the detailed simulations to allow for a final decision to be taken by October 2020.

O. Brüning asked to estimate when the decision on the Q4 rotation would be needed for the cryo-Service Module. He pointed out that the possibility to integrate forward physics detectors is under discussion (in particular for CMS), which might have an impact on the integration in the area.

M. Zerlauth concluded that – based on the new dose estimates - it seems that the baseline (without Q4 rotation) could cope with the requirements for Run4, exploiting the gain offered by the polarity change. O. Brüning agreed it would be ideal, as if one can survive Run4, the additional work in LS3 is reduced and the cost to replace/refurbish the Q4 would be considered within the CONS project.