I.Béjar Alonso

8th Meeting of the HL-LHC Parameter and Layout Committee

Participants: Gianluigi Arduini, Amalia Ballarino, Isabel Bejar Alonso, Helmut Burkhardt, Samy Chemli, Paolo Fessia, Herve Prin, Stefano Redaelli, Ezio Todesco, Jan Uythoven, Markus Zerlauth

Excused: Oliver Bruning

The slides of all presentations can be found on the website and Indico pages of the PLC:

HL-LHC PLC homepage: https://espace.cern.ch/HiLumi/PLC/default.aspx

Indico link: https://indico.cern.ch/event/297333/

M.Zerlauth opened the meeting by approving the minutes of the previous meeting and reviewing the agreed actions:

- The minutes have integrated the comments from S. Redaelli and R. Jones and R. Steinhagen. This last has confirmed that the impedance calculations for the wire compensator were done and the results have not shown any considerable increase of global impedance as already presented partially during the Daresbury meeting.
- During last meeting R.Garoby requested a definition of the bunch length to be added to the HL-LHC glossary. It has been done and can be found in https://espace.cern.ch/HiLumi/PLC/SiteAssets/LHC_Glossary_high_resolution.pdf
- As second action it was requested to P. Fessia to complete the equipment survey for IP4 and update the space reservations accordingly. The procedure will be presented today.

M.Zerlauth (slides) announced the new organization of the HL meetings. All the meetings will be held on Tuesday afternoons. The 2014 calendar can be found in the slides. In average, there will be a TC every 4 weeks and a PLC and a SC every 8 weeks. TCs and PLCs will be jointly organized. O. Brunning will be the chair of both meetings and I. Bejar Alonso and M. Zerlauth will be co-chairs and scientific secretaries.

The invitations to the TC will be adapted to the topics that will be discussed during the meeting, TC members are encouraged to forward the invitations to colleagues they believe should participate to the discussions.

A tentative list of topics to be treated during the next 6 months has been prepared and the speakers will be contacted in the next weeks to finalize the title and date of the presentations.

Update of Hi-Lumi parameters following RLIUP – (G.Arduini - slides)

The presentation is a summary of the HL-LHC deliverable report D1.3: "beam parameters at LHC injection". It includes production schemes for nominal performance and alternative production schemes to be used in case it is needed to reduce the electron cloud effects in the LHC. Both schemes are for 25ns.

G. Arduini recalls the main parameters of the Standard and BCMS (Batch Compression Merging and Splittings) schemes.

Scheme	# bunches/beam	# Colliding IP1-5	# Colliding IP2	# Colliding IP8
Standard	2748	2736	2452	2524
BCMS	2604	2592	2288	2396

He also provides a description of the scheme and the assumptions taken for the minimum rise-time and pulse length of the different kickers and the parameters at collision.

Scheme	Nb [1011]	e*n coll [mm]	# colliding bunches IP1,5	Crossing angle [mrad]	Beam-beam separation [s]	Lvirtual [1034cm-2s-1]
Standard	2.2	2.5	2736	590	12.5	21.3
BCMS	2.2	2.4	2592	590	12.5	20.2

The description includes also the assumptions to calculate the integrated performance as follows:

Scheme	Levelling Time [h]	Opt. fill length [h]	η [%]	ϕ [%]	Integrated Luminosity [fb-1/y]	Max. Mean Pile-up density/Pile-up [ev./mm]/[ev./xing]

Standard	7.4	8.7	50	37	255	1.25/140
BCMS	7.4	8.7	50	37	241	1.25/140

Looking at past performance and considering other assumptions we can find the parameters at injection from SPS:

Scheme	SPS Extraction		LHC collision (min. value – IBS)	LHC collision		
	Nb [1011]	en (H/V) [mm]	en (H/V) [mm]	Nb [1011]	en coll. (H/V) [mm]	Blow-up from SPS ext. [%]
Standard	2.3	2.0/2.0	2.3/2.0	2.2	2.5/2.5	25
BCMS	2.3	2.0/2.0	2.3/2.0	2.2	2.5/2.5	25

The presentation includes also other alternative filling patterns to mitigate the e-cloud effects. The schema "8b+4e" minimizes the heat load but also reduces the number of bunches and as hence results in a lower integrated luminosity:

Scheme	Levelling Time [h]	Opt. fill length [h]	η [%]	ϕ [%]	Integrated Luminosity [fb-1/y]	Max. Mean Pile-up density/Pile-up [ev./mm]/[ev./xing]
8b+4e	8.3	9.4	50	38	188	1.2/140

As conclusion the parameters obtained with the two 25 ns schemes give parameters that can be realistically obtained after the full upgrade of the SPS according to the LIU project.

In case we have to mitigate the e-cloud effects we have an alternative schema (8b+4e)

Discussion:

M.Zerlauth starts the discussion asking what should be considered the most demanding injection scenario that must be considered for the definition of the injection protection systems. G. Arduini replies that probably the BCMS has to be considered as the worst scenario. After a brief discussion he confirms that the determining parameter is energy density in this case, hence the total intensity divided by the emittance. In his opinion we have to make a design that can accommodate the lowest (realistically achievable) emittance.

J. Uythoven considers that we should not state as conclusion that the parameters at injection for the different schemes are limited to those currently foreseen to be reached by the LIU project but we should assume for the design that we can achieve the nominal bunch populations with the reduced emittances of the BCM scheme (288b with 2.3E11 @ 1.4um). In this way we are not limiting ourselves and we can find alternative schemes.

G. Arduini replies that we can still reduce the length of the trains or find other alternatives to mitigate too excessive peak energy densities. He also states that when considering machine protection we have to assure protection up to the highest limit we think the machine can reach.

J. Uythoven and M.Zerlauth support this point and confirm that we have to consider the most extreme scenario. S. Redaelli points out that we have not to limit ourselves to protection at injection level but also think of all other collimators during the whole cycle.

S. Redaelli questions if we have to use the full train assumption and that so all bunches are lost on the same spot. Maybe we cannot find any material able to resist to such assumption. The different possibilities are discussed and it is stated that in the worst case the number of bunches per injection will have to be reduced.

G. Arduini emphasizes that it is different to reduce the number of bunches for injection than the total. The different cases have to be evaluated in detail.

Questioned on the lifetime calculation, G. Arduini details that the model recalculates the lifetime every 5 min. The burn off effects are limited to the core. He is not sure of the relevance of the loss in the tails but those are slightly contributing to the luminosity but in any case he will consider it.

Action: The injection parameters will be added to the 'LHC baseline parameters' using the most demanding set for the design of the injection protection systems.

D1 length reduction/strength increase (+correctors in LSS magnets) – (E. Todesco - slides)

E. Todesco presents on behalf of T. Nakamoto and Q. Xu the change of length and field of the D1 magnet.

He starts with a description of the main parameters of the D1 separation dipole and the assumptions that were taken in consideration for its first design. Considering

that the initial calculations were strongly conservative and it is possible to reduce some margins it is proposed to change the operational field from 5.2 to 5.6 T and reduce the length from 6.7 to 6.3 m so that the magnet can be tested at KEK without requiring a full refurbishing of their test bench installations. This change of length and operational field will entail a current increase from 11 to 12KA.

Discussion:

There is an intense debate on slides 4 and 5 which summarize the parameters and the field quality (b3 component) of the 3 options. In particular G. Arduini points out the different performance depending on the operation energy.

P. Fessia points that the design can be further optimized making the slope as flat as possible.

A. Ballarino points that while having a clear advantage for the testing possibilities at KEK, the increase in nominal field and current implies lowering margins and that this change can have an implication on the power convertors and the eventual additional cost should be balanced against the cost of modifying the test station.

E. Todesco replies that the alternative would had been to make the test at CERN but this does not allow a fast feedback on the design and that each facility must have the possibility to test what they are designing.

A. Ballarino insists on the fact that several similar changes like this have systematically increased the load on the powering system (and sc links foreseen for these magnets).

G. Arduini asks if circuits in the current LHC are designed for ultimate current. M. Zerlauth confirms that it is the case for all the cold part but that in a few places there are limitations through the normal conducting cables.

E. Todesco asks which is the margin that exists for the circuits. A. Ballarino informs that there is normally a 10% margin on the circuits.

Action: E. Todesco to contact EPC (V. Montabonnet) to obtain confirmation that the change does not have major implications for their system.

New template for conceptual specifications – (I. Béjar Alonso - slides)

I.Béjar Alonso

I.Bejar Alonso states that moving from the concept to the development stage implies an assessment and a validation of the requirements for the different systems that we have to install for HL-LHC. That means to create a baseline for Performance parameters, Technical parameters, Configuration and installation constraints, Interface parameters and Cost and Schedule constraints.

To simplify the process the WP Leaders will have to fill a template that contains all those requirements:

https://edms.cern.ch/file/1311290/0.4/LHC-PM-QA-517.V04.21.01.2014.docx

The validation of the different documents will allow for the preparation of the first baseline for the Performance, technical and interface parameters. It will also allow to check the configuration and installation constrains, will allow the preparation of the first Cost and Schedule baseline (future EVM) and give the green light to the development stage

Discussion:

A.Ballarino points out that the LARP collaboration will need a template also for specifying components. I. Bejar Alonso says that this template is not for describing components as the functional and technical specifications are prepared after the conceptual specifications (see life cycle). A template will be prepared for them in the near future.

To answer the question of M. Zerlauth, I. Bejar Alonso points that there will be conceptual specifications for the systems which are in the HL-LHC Baseline and also for design options that today are considered as possible alternatives.

Procedure for space reservations for HL-LHC – (P.Fessia - slides)

P. Fessia recalls the necessity of having a procedure for space reservation and why the present system based on ECR is not sustainable. He states some of the benefits that we should obtain from using a procedure for Space reservation such as a clear link between the configuration database and the triggering document, or space reservations traced in 2D drawings, but also in 3D models, space reservations linked to an equipment/system... He also points out the importance of having a space reservation system for equipment not being directly on the beam line.

The procedure described in the slides and in the EDMS document 1344489 implies the creation of "fake" equipment that represents the reservation which are connected to the 2D drawings and 3D models. When the design file is approved the space modifications are managed using ECRs. The procedure for equipment not on the beam line is similar and is also described in the presentation.

The procedure is already active and should be used for all new space reservations.

Discussion:

H. Prin asks why there is a different procedure for objects that are installed on the beam and those not directly located on the beam. P. Fessia answers that this is due to a different treatment by the configuration and as we can not produce automatic 2D drawings outside the beam lines.

S. Redaelli asks what happens in case fo space requests when a detailed design does not yet eexist. P. Fessia indicates that you will have a box with the information that exists in the conceptual specification and that after the final design it will be replaced with the exact 3D model. In case there are still several technical options for the same conceptual specification then we will reserve the maximum space and we will see which is the priority. The prioritization is a process that will only start at a later point.

AOB (all)

It is requested to increase the current for linear correctors from 100 A to 150A.

Next meeting on 29th of April 2014.