

# MINUTES OF THE 52<sup>ND</sup> LIU-SPS COORDINATION MEETING

17/09/2014

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**List of attendees:**, B. Goddard, W. Höfle, L. Jensen, K. Li, D. Mcfarlane, E. Montesinos, G. Rumolo, E. Shaposhnikova, M. Tadorelli

**Excused:** R. Garoby, M. Meddahi

## Opening, approval of the minutes and arising matters

Comments on the minutes of the last meeting, held on 27 August 2014, were already implemented in the current version of the published minutes. A quick review of the open actions:

- The schedule for the start-up of the 800 MHz system and the associated conflicts between Linac4 and LIU-SPS schedules will be addressed today.

## Agenda

### 1. *Status of the planning of the LIU-SPS requirements for LS2:*

Areas covered by David are the SPS ring, injection and ejection and pits and surface (BA7). Areas not covered by David are the North Area, AWAKE and HiRadMad. Looking at the SPS safety chains it becomes clear that AWAKE requires a lot of cross coordination. This, however, is not in David's hands. Officially, the SPS goes up to the target, which might be arguable, since this could also be part of the North Area.

The LHC roadmap defines the frame where the injector roadmaps need to fit around. Focusing a little on the technical stops, there are two types, the end-of-year technical stops (YETS) and the extended end-of-year technical stops (EYETS). These technical stops begin 3 weeks before the 2-week Christmas break. If the technical stops were to begin with the Christmas break, these 2 weeks could be used for cool-down while the 3 weeks before could be shifted to the end of the technical stop instead. This would effectively add 2 weeks more available for access. This issue should be raised for discussion and followed-up.

Starting from the LS1 schedule as template, the LS2 overview was presented. If LS2 begins at the beginning of July, the first general access will be by middle of August. The one and a half month time between beginning of shutdown and first access was very tight for LS1. The beam will then have to be back by end of August of the following year but in practice the machines will have to be closed about three months earlier

(power tests, cold check out, etc.). This means that the 18 months of shutdown effectively reduce to only 12 months available for access. Any work that requires more time should be communicated now. Two key activities during LS2 will be the work of Eric in LSS3 and the a-C coating. Both are expected to fit in this time window. There are 2 types of work – LIU and consolidation – which for David make no difference since both take resources from the same pool. The crab cavity activities will take place before LS2 and should not be in conflict with any activities in LS2. All LIU works for SPS were taken from the corresponding EDMS document and assembled in a Gantt chart. LIU work is highlighted in red. For the moment there is little consolidation work but this is expected to fill up over time. In addition, BAX (access points) disciplines were created and the idea will be to distribute the activities among these disciplines. As an example for this, the 200 MHz activities have already been broken down in some detail after discussion with Eric and have been moved to the corresponding discipline. The same is planned for all other LIU-SPS activities after discussion with the respective sub-project coordinators.

Potential conflicts, that are visible already at this early stage and need to be monitored, are the 6 months of zone blocking (not full blocking, though) required by Eric which could get into conflict with the cabling campaign foreseen in the same zone. Moreover, the a-C coating might get into conflict with the transports. One thing to figure out is whether there is any heavy maintenance for “Monte-Charge” and whether this could be done during one of the extended shut downs.

The planning is accessible for everyone in David’s public (jocksoft). The idea is to identify potential showstoppers that would affect the length of the required access.

For now, we are tied to a 12 months access window. For the a-C coating, it will most probably be hard to do the entire ring without a smaller test before. Doing these tests during the 10 weeks of extended stop, the concrete has to be removed and re-installed which already takes 2 x 4 weeks. This will be the only opportunity to do these tests but remains very challenging. There will be a large de-cabling campaign for BA5 but there seems not to be a direct issue for the a-C coating for now. Next thing would be to speak with all coordinators to get a more detailed planning. An update should then follow in a couple of months.

**2. *Updates on the cooling requirements for the 200 MHz upgrade:***

A calculation was presented of what was planned and what is needed for the power requirements and the impact on the cooling requirements. Looking at the transmission lines, a sketch was shown with all existing lines in orange and all modified and newly installed lines in other colours. The space limitations given by the tunnel walls and the trucks used to move objects in the tunnel are very stringent (down to 90-60 mm between lines and wall/truck). Hence, there is no way that one could have

more than one transmission line per cavity. This means there will be one 350 mm line per cavity with a 750 kW limit on the average power.

Looking at the different cycles, for the LHC cycle it was discovered that with the new power plant at flat top an average power of 770 kW would be reached, which exceeds the specified average power limit of 750 kW. This average is taken from the peak power at the very start of the line over a time of 7.6 s. The change in cycle length (the LHC filling cycle is now actually 1.2 s longer, of which 200 ms are added to the flat bottom and 1 s to the ramp) is not expected to significantly affect the average power. For CV it would move the 490 kW to approximately 500 kW which is also negligible. To keep the average low the cavities have to be pulsed from peak power to 10 kW – the power sources should not be switched off to keep the loops active. This still has to be tested but there is no obvious reason why this pulsing should not work. For the CNGS-like and fixed target cycles, the average powers are always well below the limits of the transmission lines.

It would be good if the amplitude modulation from the LLRF were available before LS2 for testing. A table was shown displaying the needs from CV. These numbers were originally not based on the actual beam but on the power amplifier capabilities. Hence, all numbers provided are to be interpreted as maximum numbers. When now looking at the actual modes of operation, only about half the power is really generated.

The CV loop was designed for 4.5 MW. Up to now, only 1.8 MW was needed, which is significantly lower. With the upgrade, the present average power will increase from 1.8 to 2.2 MW with an additional average power of 2.0 MW for the new plants. Hence, a total power of 4.2 MW would be needed. This would be still within the original specifications, although the power not used by RF has been taken by other users over the years. With a re-design of the cooling plant, where there would be only 4 systems, with a better, more logical piping distribution.

A time laps movie of the ongoing work for BAF3 was shown - it has made very good progress and is following the schedule.

3. ***Follow-up on the schedule issues for 800 MHz readiness:***

There was a reminder on the planned schedule for the 800 MHz commissioning. Cavity 2 is commissioned and ready for beam production with the old LLRF. This includes amplitude and phase loops but lacks beam loading compensation which would reduce the beam impedance at the revolution frequencies by a factor 10. Cavity 1 will be equipped and tested with the new LLRF. If this is successful, the new LLRF will be installed also for cavity 2. In terms of firmware and software for the LLRF, still, the clock distributor and cavity loops are not available for either cavity. More manpower has been allocated to ensure readiness of the hardware so that the schedule can stay on track.

The new plan foresees to use cavity 2 to achieve a stable beam with  $1.1 \times 10^{11}$  ppb. Meanwhile, cavity 1 with the new LLRF will be tested at 26 GeV in October; the second test will take place at 450 GeV fixed energy in November. In a third MD, the tracking during the ramp will need to be tested and made operational. If everything works well, this would be ready by the end of this year. The main aim in any case is to commission the LLRF and to minimize any further delay.

The 2014 start-up of the SPS will take place with cavity 2 running with the old LLRF to guarantee beam availability. All necessary MDs/commissioning to set up cavity 1 should be done this year. Then the system should be installed and commissioned for cavity 2. Additional and earlier MD slots could be allocated for this in order to advance the commissioning of cavity 1. This should be given priority since it would make most sense to have the new LLRF working and then set up the high intensity LHC beams, including the doublets. Only one cavity is presently needed for the LHC beams, while the full power will be needed only after the 200 MHz upgrade.

4. ***Strategy changes for the scrubbing run as a result of the updated SPS schedule:***

The main goals for 2014 are to qualify the loss of conditioning, recover the 2012 performance, quantifying the amount of beam/time needed and to test the doublet beam to be used for scrubbing. For now, 12 bunches are already circulating and used for re-alignment.

The commissioning of the 800 MHz system has been set to the beginning of the MD time. More 800 MHz MD slots could be allocated in principle. 800 MHz commissioning could also take place in parallel during scrubbing, if needed. The coasting MD will have to take place at the allocated time because of the UA9 experiment in week 44. One option could be doing 800 MHz commissioning every 2 weeks starting from week 41.

As for the pre-scrubbing cycles, weeks 41-45 will already give some experience with 25 ns beams. As for the scrubbing run itself, the first scrubbing week will focus on investigating and understanding operation on the flat bottom in detail with an intensity ramp ideally up to  $1.5 \times 10^{11}$  ppb. At the end of the week acceleration of both standard and BCMS should be tried and the scrubbing should be qualified. The second week now taking place only in week 51 can be thought for using the doublet beam, since enough time was available beforehand for the set-up. With the open questions on the availability of the 800 MHz system, the use of doublet beams or high intensity beams still remains uncertain.

## 5. *Reports from the different working groups:*

- **Beam dynamics:** An outlook on what to expect at the Chamonix workshop: from latest analysis, the vacuum flanges are responsible for SB and MB instabilities in the SPS. All measures thought to mitigate these effects do not solve the problem due to acceleration of intense beams in the SPS. This gives even more justification to launch a dedicated impedance reduction program in the SPS. This will, however, require some good planning and should be followed up after Chamonix. Questions such as how many flanges are concerned or the effectiveness of damping should be addressed. For now, it looks like all flanges would have to be re-designed. The question was raised whether the investigation on the damping resistors is then still necessary. In reply, the correctness of the impedance model is still crucial for the beam dynamics simulations and therefore the question of the damping resistors should be followed up in any case.
- **a-C coating:** The in-situ SEY system is ready and a 24 h slot is needed to install it, which would mean sacrificing a full day of beam. The time is dominated by the pumping time. Using less time could be probably considered.
- **200 MHz and 800 MHz upgrade:** No specific comments.
- **Beam loss and machine protection:** No specific comments.
- **HBWD:** The SPS damper commissioning is difficult and pretty tight. It is tedious to get the software running, which adds more complication.
- **BI:** No specific comments.

## **AOB**

- Mauro would also like to review their activities in more detail in the near future.

## **Summary of Action Items**

## **Adjournment**

The next meeting will take place on 01/10/2014.

Tentative agenda:

KL, 17/09/2014