Minutes PSB Upgrade WG Meeting 10th December 2015

Participants: J. Abelleira, S. Albright, T. Birtwistle, A. Blas, J. Coupard, L. De Mallac, J. Devine, G.P. Di Giovanni, A. Findlay, R. Froeschl, G.M. Georgiev, D. Grenier, G. Guidoboni, M. Haase, K. Hanke, J. Hansen, I. Kobzeva, M. Kowalska, B. Mikulec, M. Paoluzzi, S. Pittet, J. Tan.

Agenda (https://indico.cern.ch/event/465398/):

1. Approval of Minutes

- The minutes of the last LIU-PSB WG meeting #164, available here, have been approved.

2. Communications

- **Party for the End of the Year:**
  - The party is planned for today at 13.00 and the room is 37-R-022.

- **Budget Rebaseline:**
  - The current baseline is closed since the beginning of December.
  - **The WP-holders are asked to start working on the rebaselining of their WP and send the new budget profiles to G.P. Di Giovanni by the end of the year.**

- **Cabling:**
  - The EN-EL Group requested 2 budget codes (BC) for the procurement of the cables. One for controls cables and another one for DC cables.
  - Both BCs have been created but no money is currently allocated to them.
  - In particular, neither the EN/EL Group nor the TE/EPC Group had previously allocated a budget for DC cables. By January 2016 an estimate of the required amount of money will be made by EN/EL (based on the requests received) and only then discussions will continue.

- **LIU Project Description Document:**
  - No comments have been received by F. Bordry and the department leaders on the present draft. The final version will be released next week.

- **LIU/HL-LHC Executive Committee:**
  - A new committee was created to perform high-level coordination of the LIU/HL-LHC projects.

- The status of the RFQ spare and the list of consolidation activities will be discussed first.

- **LIU Beam Parameter Working Group:**
  - One of the objectives of the WG is to review the assumptions for the construction of the LIU parameter tables in view of the current injectors performance.
  - B. Mikulec will represent the LIU-PSB project.

3. Follow-up of Open Actions

- C. Zamantzas/J. Tan on "Make sure that the SRR or ECR for BLM for the PSB and transfer lines is submitted. The SRR or ECR should include FLAT ionization chambers and ionization chambers to replace ACEMs." → J. Tan reported that he has no news about the status of the document.

- F. Roncarolo/J. Tan on "Prepare a document for approval about the specifications for the H0/H- current monitor electronics." → J. Tan reported that few details are still under discussion, so some additional time is needed before launching the approval process. Deadline postponed to end January 2016.

- D. Aguglia on "Approve document with the functional specifications of the power converters for BSW magnets for both the LIU-PSB and the Half-Sector Test in Linac4 addressing the open issues from v0.2" → Y. Muttoni and J. Borburgh accepted the corrections proposed by D. Aguglia and modified their comments in EDMS. The document could be released without another round of approval. D. Aguglia is now finishing the integration of the remaining comments.

- R. Froeschl on "Evaluate the possibility to remove part of the shielding to allow the installation of the new magnets BTM.BHZ10 and BTP.QNO20 for the upgrade of the BT/BTM/BTP lines." → R. Froeschl reported that he is still missing information about the amount of material to be removed from J.M. Lacroix.

- J. Tan/J. Belleman/L. Soby on "Demonstrate 200 µm resolution for low intensity beam for the turn-by-turn measurement system. Demonstrate reliable operation with new firmware/software. Electronics to be ready for deployment in EYETS 16-17" → B. Mikulec reported that a meeting was held last week to wrap up the work done during this year. J. Belleman plans to work on the system during the shutdown to get ready when protons are available again. It was agreed among all relevant parties to have regular meeting to closely follow up on progress.

- R.Froeschl, J.Tan on "Optimize the scheduled work in the radiation laboratory for the BCTs-BR.TMD currently installed in PSB section 8L1" → R. Froeschl reported that the activation of the elements is smaller than originally anticipated. The work will be certainly evaluated by the RP Group when the time comes, so the action can be closed from the LIU-PSB point of view. → **Action Closed**

4. A New RF System for the PSB

- M. Paoluzzi presented the status and planning of a new RF system for the LIU-PSB, see here.

SUMMARY:

- **Given the cost and manpower required to consolidate the present RF system, based on ferrite cavities, a new technology based on Finemet cavities was proposed as alternative for the PSB.**
- **The new technology offers the advantage of having a wideband response** compared to the canonical ferrite cavities.
- In order to maximize the use of the wideband response, **solid-state amplifiers will be employed**, reducing significantly the need for vacuum tubes and, hence, reducing the costs.
- To validate this choice, a **wide range of issues have been addressed**: From how to produce the needed RF power to investigate the radiation hardness of solid-state devices, from how to build dedicated low-level electronics for active cancellation of beam-induced voltages and allow for multi-harmonic operation to resolve any beam stability issues.
- **The Finemet will be used to also replace the C16 cavities, as it turned out that the frequency response of the Finemet is wide enough to allow for the controlled blow-up in the PSB.**
- The system is modular and the **RF power amplifiers are designed to ensure operation with 2 broken RF Mosfets (out of 16)**. The system would also **ensure operation with 6 broken cells per ring (out of 36).**
- **There is currently an issue with BPP5L1.** The pickup is installed in Section 5L1 and **needs to be removed to allow the new installation.**
    - The proposal, under discussion with the Vacuum and BI Groups, is to **use the identical pickups in Section 8L1 and Section 11L2, respectively for operation and as a hot spare.**
    - The additional identical pickups in Section 1L5 and 14L4 could be removed, if needed.
    - The pickups in Section 8L1 and 11L2 will be provided with new head amplifiers and tested before LS2 to make sure about their readiness for operation.
    - The pickups removal will be documented in a single ECR which will describe the changes for the whole RF system.
- The rack layout for control and power supply has been previously agreed, see here.
- The system will be composed by several units: **A dedicated test place for parts acceptance, test and maintenance is needed. The place already available in B364 will be dedicated to this task.**
- A preliminary planning is available, but it needs to be discussed with D. Hay and J. Coupard. One official request is to have the services available starting from January 2020.
- **M. Paoluzzi mentioned that the only part which is not accounted in the budget is the decabling activity:**

- K. Hanke said that the decabling work is not covered by the LIU budget.
- B. Mikulec mentioned that she thinks to remember that, about two years ago, it was agreed the following:
  - If the cables have to be cleaned up, the work will not be included in the LIU budget,
  - **but if the cable removal is part of a cable replacement, the budget will have to come from the LIU work-packages concerned.**
- M. Paoluzzi added that indeed he vaguely remembers the budget of one million allocated for the cables replacement.
- **K. Hanke invited M. Paoluzzi to find out if the RF Group has money allocated for any decabling work. → Open Action**
- Meanwhile before agreeing on any budget expenses for decabling, G.M. Georgiev will have to first come back with an estimation of the work needed and related expenditures.

- **The project study phase is now completed, all results have been reported at the project review and the full deployment plan has been endorsed by the management.**

Assigned to	Due date	Description
K.Hanke	2016-01-31	Clarify with M. Paoluzzi about the existence of money allocated for decabling work within the budget of LIU-PSB 4.1 work-package and more generally about the strategy for any budget allocated to decabling work within the LIU-PSB project.

Detailed Description

- **Motivations for a New RF System of the LIU-PSB:**
  - Heavy interventions will be needed on the RF system to cope with the new intensity and energy foreseen for the 2 GeV beam operation.
  - Deep and costly interventions are required on the C02 and C04 RF systems due to aging equipment.
  - **Given the cost and manpower required to consolidate the present system, it was proposed to use a relatively new technology and redesign the PSB RF system.**

- **The new technology chosen is based on the Finemet material which has the advantage of having a wideband response**, compared to the canonical ferrite cavities.
- In order to maximize the use of the wideband response, **solid-state amplifiers will be employed. This is a key choice as it avoid using vacuum tubes which would have a significant impact on the final cost.**
- The decision to use a new system implies that a wide range of issues had to be addressed to justify similar change: From how to produce the needed RF power to investigate the radiation hardness of solid-state devices, from how to build dedicated low-level electronics for active cancellation of beam-induced voltages and allow for multi-harmonic operation to resolve any beam stability issues.

- **The Finemet will be used to also replace the C16 cavities, as it turned out that the frequency response of the Finemet is wide enough to allow for the controlled blow-up in the PSB. This is a decision which was first considered during the review held in September 2015 (report available here).***

- **An intense testing campaign with beam-based measurements was carried in the last year:**
  - Beam tests proved the system **ability to produce intense beams equivalent to what achieved with standard operation with ferrite cavities.**
  - **The system is capable of operation at h1, h2 and h10.**
  - All system components are largely **fine within thermal and current limits even at high duty-cycles.**
  - **The effects of radiation on the amplifiers in the ring can be mitigated and re-adjustments will be needed every ten years.**
  - **The Low-Level digital electronics compensate beam loading and maintain beam stability.**
- Additionally, **simulation indicates that operation will be possible at 2 GeV and for beam intensities as high as 2E13 proton-per-pulse.**

- **Main System Characteristics:**
  - **A modular system** based on wideband, solid-state driven identical cells.
  - This modular system has the advantage of being mostly composed of standardized units.
  - **High performance digital Low Level electronics.**
  - **Despite the increase number of gaps, the beam impedance will be lower than in the current situation.**
  - Ample margin. The **RF power amplifier designed to ensure operation with 2 broken RF Mosfets (out of 16)**. The system would **ensure operation with 6 broken cells per ring (out of 36).**
  - PLC interlocks to individually track the system evolution.

- **Preliminary Installation Layout:**
  - Two 6-gaps units can be installed in each Section and Ring.
  - The amplifier will be installed on one side only. The other side could become available for future improvements.
  - The cavities and power amplifiers will be cooled by demineralized water and the contribution to air heating is negligible.
  - Four PSB Sections are presently used by the RF systems: 5L1, 7L1, 10L1 and 13L1. The new system is more compact and **Section 10L1 should not be used**. It is kept in stand-by for the time being, but in the future it may be released for any other equipment.

- **Issue with BPP5L1:**
  - Section 5L1 is presently filled with the C16 RF system and the pickup BPP5L1. **Both to be removed to allow the new installation.**
  - Five similar pickups are currently installed in the PSB machine:
    - **The pickups in Sections 1L5, 8L1, 11L2 are not used.**

        - **The pickup in Section 5L1 is used and the one in Section 14L4 is the current hot spare.**
        - **The proposed plan is:**
            - **Use the pickup in Section 8L1 and the one in Section 11L2 as hot spare.**
            - **Remove the pickup in Section 5L1.**
            - Since the pickups in Section 1L5 and 14L4 will not be needed in future, they could be removed.
            - The plan is to install the head amplifiers in Section 8L1 and test the pickup during 2016.
            - During 2016-2017 EYETS, the head amplifiers will be installed in 11L2 and test it during 2017. → The goal is to be **ready operationally with the new pick-ups for LS2.**
            - **The details of the proposed changes are discussed with the TE/VSC and BE/BI Groups.**

- **Racks Layout:**
    - For each Section, one rack per Ring is needed for control plus an additional rack for the PLC interlock. In total, the system will need **15 racks for control**.
    - Eight racks for Section are needed for the power supply, two per ring. In total **24 racks will be needed for the power supply.**
    - The location of the racks in BAT/BRF1 and BRF2 is such that the cables length to the equipment is minimized.
    - The **complete layout was discussed and approved**, please refer here. In summary:
        - BRF1: Racks for power supply of Section 13L1 and for controls of Sections 7L1 and 13L1.
        - BRF2: Racks for power supply and control of Section 5L1.
        - BAT: Racks for the power supply of Section 7L1.

- The system will be composed by several units: **A dedicated test place for parts acceptance, test and maintenance is needed. The place already available in B364 will be dedicated to this task.**

- **Installation Planning:**
    - **All system elements will be assembled, tested in the test place and ready for installation before beginning of LS2.**
    - The installation will start after the cool downtime, in January 2019, and it planned to last for 15 months, followed by 4 months of hardware test:
        - B. Mikulec commented that she remembered that the hardware test is foreseen to last 5 month and not for months. J. Coupard replied that the five months are the sum of the hardware test (4 months) plus the cold check-out (1 month).
        - B. Mikulec asked about the length of the access to the Ring: She was aware of it lasting 14 months. J. Coupard clarified that the access to the PSB machine will last 15 months and start in January 2019 to end in April 2020.

    - The services will be needed starting from January 2020. As a side note, vacuum will not be strictly necessary, in fact either a good level of vacuum would be required or it would be better not to have it. Something in between is to be avoided.
    - J. Coupard invited M. Paoluzzi to **make sure all the activities are planned with D. Hay** and, very importantly, that they **account for some contingency.**

- G.M. Georgiev asked for when the RF Group expects support from the EN/EL Group for the cabling of the test stand in B364:
    - M. Paoluzzi and M. Haase replied that the infrastructure is already there and probably no additional support is needed.
    - K. Hanke asked to confirm if this part of the work is included in the budget. M. Paoluzzi confirmed this was already included in the initial budget request.

- **M. Paoluzzi mentioned that the only part which is not accounted in the budget is the decabling activity:**
    - K. Hanke said that the decabling work is not covered by the LIU budget.
    - B. Mikulec mentioned that she thinks to remember that, about two years ago, it was agreed the following:
        - If the cables have to be cleaned up, the work will not be included in the LIU budget,
        - **but if the cable removal is part of a cable replacement, the budget will have to come from the LIU work-packages concerned.**
    - M. Paoluzzi added that indeed he vaguely remembers the budget of one million allocated for the cables replacement.
    - **K. Hanke invited M. Paoluzzi to find out if the RF Group has money allocated for any decabling work.**

- Concerning the ECR needed for the pickups removal, all the changes will go in a single ECR reviewing the changes for the whole PSB RF system. The Vacuum and BI Group will be involved in this activity.

- **The project study phase is now completed, all results have been reported at the project review and the full deployment plan has been endorsed by the management.**
- **K. Hanke confirmed that the new Finemet-based RF system for the LIU-PSB has been endorsed both after a thorough review and at the IEFC. The work is solid and there is a full support to implement the new proposed system. Congratulation to all the people involved for their effort so far.**

5. AOB

- The next meeting is planned for the 19th January 2015. The meeting will follow the new schedule, on Tuesday 16:00-17:30 in 864-2-B14.
- B. Mikulec asked A. Blas about the recent internal review to discuss the status of the TFB amplifiers and electronics. A. Blas mentioned that the work is still ongoing and the timeline will probably change, but not the final goal to deliver a working system

for LS2. A review of the status of the TFB is scheduled for the LIU-PSB WG meeting which is planned for the 9th February 2015. A. Blas is expected to report more details during this meeting.

- J. Coupard reminded that the collimators (shavers) in the LIU-PSB need discussed at the integration meeting. R. Froeschl asked if beam parameters are already available for preliminary estimation to be done by the RP Group. B. Mikulec mentioned that the work is being done by M. Kowalska and E. Benedetto and it is ongoing. E. Benedetto will come back from the maternity leave next week and she will be asked to look into it.