

Minutes PSB Upgrade WG Meeting 7th June 2016

Participants: S. Albright, E. Benedetto, J. Coupard, L. De Mallac, J. Devine, G.P. Di Giovanni, T. Dobers, V. Forte, R. Froeschl, A. Funken, G. Guidoboni, M. Haase, K. Hanke, I. Lamas Garcia, B. Mikulec, S. Moccia, M. Morgenstern, M. Paoluzzi, S. Pittet, J. Tan, W. Weterings.

Agenda (<https://indico.cern.ch/event/537499/>):

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1. Approval of Minutes

- [The minutes of the LIU-PSB WG meeting #174](#) have been approved.

2. Communications

- **LIU and Equipment Groups Dedicated Meetings:**
 - A dedicated meeting was held with the EN-HE Group the 30th May 2016, see [here](#).
 - A dedicated meeting was held with the BE-RF Group the 31st May 2016, see [here](#).
- **LIU-PT Meetings:**
 - Last meeting relevant for LIU-PSB was held the 26th March 2016, see [here](#).
 - Several discussions about the duration of the EYETS and the time left for the decabling. EN-EL will have to work in shift over week-ends to make sure the deadline is met.
 - BE-OP will make an effort to reduce the time needed for the hardware commissioning from 4 to 3 weeks. The plan will be presented at the IEFC. Squeezing the hardware tests also entails an increased risk that there could be delays for the start-up.

3. Follow-up of Open Actions

- M. Buzio on "Provide document describing the specifications of the B-Train system" → M. Buzio did not attend a meeting. He will be contacted privately.
- M. Paoluzzi on "Provide feedback about the estimated deadline for delivery of the 800W power amplifiers for the PSB TFB. The current estimated date is July 2017" → The status was presented [today](#). **Action Closed.**
- F. Boattini on "Update the schedule of the powering tests foreseen in B245 for the commissioning" → The new schedule was presented [today](#). **Action Closed.**
- S. Moccia on "Prepare a document containing the requests received for the demineralized water cooling system." → S. Moccia reported that the document has been launched for approval, see [EDMS 1697679](#). **Action Closed.**

4. LS2 Master Schedule

- J. Coupard presented the most up-to-date LS2 Master Schedule, see [here](#).
- **A draft of the schedule is available on EDMS at <https://edms.cern.ch/document/1687788> (EDMS reference: ACC-PM-MS-0002).**
- The schedule for the injectors is ready, while the one for LHC is under revision. In a second step the information about the experimental areas will be added as well.
- A long cool-down is foreseen (6 weeks), which means that **no access to the PSB machine is allowed until January 2019.**
- Nevertheless, for few dedicated tests to be done with the magnets pulsing, the access could be organized.
- The work will start in January 2019 and **finish sometime at the beginning or middle of April 2020. At this point all services have to be available for the period of the "Hardware Tests".**
- **Afterwards, 4 months of "Hardware Tests" are planned, followed by 1 month of "Cold Check-out" and finally 2.5 months of "Beam Commissioning".**
- **Any request of tests inside the shutdown period (January 2019-April 2020) must be declared to D. Hay (Facility Coordinator) and B. Mikulec and A. Akroh (PSB Recommissioning Coordinators):**
 - This period is assumed to be used for accessing the machine, **but there will be several tests which need the availability of the few services. Their availability has to be checked and the constraints of any access have to be evaluated.**
 - **All the WP-holders are invited to have a look at the schedule and provide feedback.**
- An example of a possible conflict was discussed by S. Moccia (EN-CV) and M. Paoluzzi (BE-RF):
 - EN-CV requested one year to renovate the cooling station, and only (partial) ventilation system could be provided by EN-CV in 2019.
 - On the other hand, BE-RF will need several services for tests in October 2019.
 - **J. Coupard remarked the importance to provide any information, even if preliminary, in order to centralize the requests and optimize the schedule. The milestone showing when each service has to be available will be added in the next version of the document.**
- W. Weterings asked when the access to the radiological hot areas will be allowed. R. Froeschl replied that **any work that can be delayed should be postponed to the end of the EYETS. For the other cases**, for instance for TE-ABT to work on Section 1L1, then **the access will be allowed immediately, but the procedure has to be worked out to minimize the accumulated dose.**

5. POPS-B Project Update and Feedback from POPS Experience


- F. Boattini presented the status of the POPS-B project and the modifications done in view of the feedback from the experience with POPS, see [here](#).
- **Power Converters to Be Installed in POPS-B:**
 - Main power converters (MPC): 2 + 1 spare.
 - Quadrupole trims: 2 + 1 spare.
 - Injection/Extraction trims: 4 (2 per each kind in ring 1,4 and ring 2,3) + 2 spare, one of each type.

- **Building 245 (B245) Civil Engineering:**
 - **B245 is completed.**
 - The formal visit and acceptance of the external and internal construction was done on Tuesday 31st May 2016. **Few minor modifications need to be done, but otherwise the building is ready for the equipment installation.**
 - Nearly all equipment positioning has been integrated. **Few elements have been integrated with temporary dimensions, but should be finalized soon:**
 - An example is the **cooling and ventilation system and the information should be available by September 2016.**
 - Concerning the power converters, 2/3 have been integrated up to the last detail. The **quadrupole magnets are still under design. According to the plan the design will be finalized during the first quarter of 2017.**
 - For the storage capacitors, 90% of the technology has been agreed.
 - The cable ladders are almost in the final version. About 95% of them are ready for EYETS.
 - **The space for the reference magnet was presented to A. Beaumont (TE-
MSC-MM), but no official approval was received yet by TE-
MSC-MM.**
- **Purchase Orders:**
 - The purchase orders have already started and are planned up to the EYETS.
 - **The main relevant modification to the original plan is to purchase the storage capacitors (2 MCHF) in January 2017. The purchase was originally planned for September 2016, but following the incident with POPS, some more investigations is needed, hence the small delay. This delay does not affect the overall planning.**
- **Activities Planned until EYETS:**
 - The first work in B245 will be carried by EN-EL in June 2016: The installation of the lightning and the first part of the cable ladders.
 - The second part of the cable ladders will be installed in September 2016.
 - EN-EL will install the auxiliary cabinets in November 2016.
 - In December 2016, TE-EPC will take care of the installation of the configuration switches. These switches are critical elements as they allow to choose between operational and spare elements, but also to switch from POPS-B to MPS (and viceversa).
 - The cables to connect B245 to B271 are going to be purchased by October 2016 and will be installed in January 2017.
 - The connection to the dummy load will happen during the EYETS, in February 2017.
- **POPS Experience Feedback:**
 - **Short circuit in the DC1 power converter happened in February 2016**
 - The fault in the DC1 closed in short circuit the storage capacitor bank as well. As a consequence, the fuse between the storage capacitor container and the DC converter was blown.
 - **The fault happened twice during this year:**
 - **The first time the reason was a connector not properly inserted.** The connector was an important one, as it allowed to measure the output current of each leg. → **The lesson learned was that the failure on one (out of six) legs could propagate to all DCDC converter.** Modifications are put in place to avoid future similar problems.

- **The second fault happened on power converter side, as the leg was not properly repaired in first place. It is important to remark that the troubleshooting guide from the power converters suppliers was followed. The major lesson learned is that each repaired stack is to be tested before restarting, possibly in an external platform.**
 - **Another major fault happened when restarting the POPS from degraded mode to full operational mode.**
 - **One capacitor was short circuited causing a short circuit of all other capacitors in the storage bank, releasing a lot of energy.**
 - In this case the fuse connecting the capacitor bank and the DC converter was not helpful to reduce the impact of the energy discharge.
- **Integrating the Feedback from the Experience with POPS into POPS-B:**
 - **Reduce the fault energy in case of capacitor short circuit:**
 - **Plan to divide the capacitor bank into 4 blocks of 0.78 MJ and protect each block with a fuse.**
 - Acceptable compromise, instead of over-protecting the system which would make its maintenance for operation complicated.
 - Fuses, melting, will help to strongly limit the energy losses.
 - **Any short circuit will affect 1/4 of the capacitor bank and the fuse will melt. The cost of each fuse is about 6-7 kCHF.**
 - Implementation ongoing for POPS.
 - **Improve design of capacitors:**
 - **Performing ageing tests on 4 different capacitors since February 2016.**
 - Ageing tests shall be finished by July 2016 and discharge tests shall be completed by October 2016.
 - The discharge tests are needed to investigate the resistance of the capacitors to short circuits. After these test another ageing test will be performed to measure how much capacitance is left.
 - **These tests are the main reason to move the purchase of the storage capacitors in January 2017.**
 - **Improve design of capacitor room following explosion analysis:**
 - **A consultant was hired to study the POPS explosion of the DSP1 and propose solutions for the future.**
 - The pressure wave caused by the explosion will be calculated to estimate the effect on the room containing the capacitor bank.
 - This work will **cost about 60 kCHF.**
 - Meanwhile some semi-empirical solutions are investigated as well. The main idea is to place over-pressure rupture points in strategic areas in the room/container hosting the capacitors. W. Weterings asked if this rupture points will be always kept open. F. Boattini replied that the standard commercial solutions are made of thin metal fibers which isolate the zone, but break under pressure to release the pressure itself in the area.
 - The area around the storage capacitor bank will be delimited.
 - **Study alternative protections in the power converter:**
 - **Fast DC circuit breaker in the form of a semiconductor which can turn on and off quickly several kA.** The circuit breaker could be installed between the capacitor container and the DC converters.
 - **Install 2 diode freewheel in the DC converters and AFE converters** to avoid negative current circulation in the other leg of the capacitor containers.

- **Build an offline test platform:**
 - To allow to repair and test faulty components.
 - It could be used as a test bench for alternative configurations of the system.
- **POPS-B Planning Update:**
 - Because of the issues with POPS, quite some time had to be dedicated to the POPS repair, affecting the planning for POPS-B.
 - **Several items in the planning had to be seriously reconsidered.**
 - **Modifications of the capacitor room are needed and additional openings in the walls of B245 will be required. This work will have a cost and the plan is to use the left over money in BC76805.**
 - **Added extra 4 months to the construction of the MPC:** They were expected to be ready by September 2017 and the deadline has been shifted to beginning of 2018.
 - **The delay on the MPC impacts the commissioning time for the power converters, shrinking it.** On the other hand, during the preparation of the first schedule some margin was taken to define the commissioning time.
 - K. Hanke asked if the project is still on time → **F. Boattini replied that, despite the issues with POPS and following re-arrangement of the main schedule for POPS-B, the project is overall still on time.**
 - B. Mikulec asked if the **8 weeks allocated for the "System test on PSB magnets" could be shifted towards the hardware commissioning. The reason being that during this time in principle the PSB machine could not be accessed. F. Boattini replied that in principle delaying the test is not an issue and could be done if needed.** This will have to be discussed with D. Hay and J. Coupard who are preparing the schedule for LS2. It is also important to note that these tests will not be done continuously during the 8 weeks. If any group needs one or two days to access and work on any equipment, this could be organized as well.
- K. Hanke asked about the **status safety files for B245**. F. Boattini mentioned that he has been working on the descriptive file, but following the experience with POPS, several modification will have to be implemented. **Some additional time is needed for a complete update of the safety files.**

6. TFB Amplifier Prototype

- M. Paoluzzi presented the status of the prototype for the TFB amplifier, see [here](#) .
- The requirements for the system are:
 - Output power: **800 W**.
 - Output load impedance: **50 Ω**.
 - Small signal bandwidth: **0.01-30 MHz (100 MHz upper frequency would be preferable).**
 - Power bandwidth: **0.1-30 MHz**.
 - Gain: **54 dB**.
 - Number of required units: **20 (4 units per ring plus 4 spares)**.
- Few designs of the impedance transformers were investigated:
 - After several tests, it was decided to use the 9-to-1 input-output impedance transformer.
 - **The power was tested up to 400 W, but at this power it was not possible to reach the bandwidth of 30 MHz and relevant distortion of the 2nd and 3rd harmonic was observed.**

- **At 200 W, the prototype fulfills the requirement, but for the output power.**
- **M. Paoluzzi proposed to use 4 amplifiers to reach the specified output power of 800 W.**
- The 4 amplifiers will be combined in a 3U box together with splitters and combiners. The system will be **water cooled**.
- The bandwidth was tested today and ranges from 500 Hz to about 500 MHz.
- The plan is to use a standard driver module, the same employed for the Finemet system.
- **The power supply will be external**, and it is going to be a commercial unit, which has been already purchased.
- **Schedule and cost:**
 - **Full scale prototype built and tested by August 2016.**
 - **The final design for the different components will be done by September 2016.**
 - **Parts procurement and assembly of 20 units by February 2017.**
 - **Testing to be done by May 2017.**
 - Concerning the **driver**, the production is already started as this project is done in conjunction with the PSB Finemet system, and it should be ready by end 2016.
 - **The estimated cost is about 160 kCHF.**
- K. Hanke asked if the cost is included in the current baseline for LIU-PSB. M. Paoluzzi replied that A. Blas mentioned that **the proposed cost is within the current allocated budget for the TFB amplifiers.**

7. AOB

- K. Hanke reported that the CET data report that the **project spending is about 50%, in line with the expectations.**
- J. Devine reported that he has been working on the **ECR for BCER. The approval has been launched and the document is available on [EDMS 1698110](#)**.
- W. Weterings mentioned that **the the PSB injection system mock-up area will be moved from B245 to B271.** Unfortunately, in the new location concrete walls are not present. Therefore, concrete blocks will be used to install the equipment. The new infrastructure will the cost few additional kCHF. K. Hanke recommended to charge the expenses in the BCs of the PSB injection area for the time being and if these additional money are needed in the future for some previous foreseen equipment, the management could help sorting the issue.
- E. Benedetto reported about the activities ongoing concerning optic studies. **In particular the document concerning the parameters for the PSB absorber/scrapper is released, see [EDMS 1578463](#)**. The major change was to follow S. Gilardoni's request and include the scenario with ISOLDE at 2 GeV (and not 1.4 GeV as originally assumed).
- I. Lamas Garcia reported that EN-STI-TCO Group is indeed performing the simulation for the transient state of the PSB absorbers. The simulation could be presented in one of the next LIU-PSB meetings.
- K. Hanke reported that an SRR is available for the PSB scrapers (<https://edms.cern.ch/ui/file/1612378/1.0/PSB-LJ-EC-0007-10-00.pdf>), but not yet an ECR. The ECR has to be written when the engineering specifications are released. Since an ECR is also needed for the dismantling of the old scrapers, the proposal is to put both the new installation and the removal of the old system in one ECR, to be written by EN-STI. → **Open Action.**
- B. Mikulec asked M. Paoluzzi if he could investigate the **status of the Linac4 (L4) chopper:**
 - **The original maximum specification for the chopper was 100 μs per ring, plus the head and tail of the pulse which would bring it to a maximum length of 500 μs.**

- Unfortunately, because of issues with the L4 source and the impossibility to reach the nominal current performance, in order to fulfill the requirement for ISOLDE a **maximum length of 150 μ s would be needed. The limitation comes from the new distributor system.**
- **On the other hand, the specification of the chopper have remained to 500 μ s. This would mean that the PSB could not provide as high intensity as today to the ISOLDE facility with the Linac4 upgrade.**
- M. Paoluzzi replied that he will follow up this issue, but it is not clear to him how much room is left to improve the system. Maybe the solution could as simple as modifying the amplifiers. Anyway, similar studies may take some time. B. Mikulec reminded that in principle the Linac4 connection could happen as early as the end of 2016.
- G. Guidoboni reported that the HST is progressing well and a detailed planning is in place to install the equipment on the girders. The schedule is indeed rather tight.
- V. Forte reported that the recent measurements with beam of the recombination kickers rise time will be presented in the next MSWG. The results will be presented in the LIU-PSB WG at the end of July in combination with the work done by TE-ABT on the hardware and simulation.
- Next meeting is scheduled for the 21st June 2016.

Assigned to	Due date	Description
M.Calviani/I.Lamas	2017-09-01	Prepare the ECR for the PSB scraper/absorber describing both the dismantling of the current equipment and the installation of the new one.