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Main Injector BPM Review Committee Report of the meeting on July 25, 2005

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Introduction

P. Bhat and M. Martens formed a committee to review the status and plan for the completion of a new Main Injector Beam Position Monitor (BPM) system. The committee met on July 25th, 2005 with the following agenda:

- Main Injector Operation in the future – Ioanis Kourbanis
- MI BPM requirements – Dave Capista
- MI BPM upgrade overview – Bob Webber
- MI BPM hardware overview – Manfred Wendt
- MI BPM online software overview – Luciano Piccoli
- MI BPM applications programs – Brian Hedricks
- BPM Upgrade cost and schedule – Steve Wolbers

Following this there was a round table discussion with the committee members, presenters, and interested audience members. This report summarizes the conclusions and recommendations of the committee.

The charge given to the committee was:

- Are the requirements for the Main Injector BPMs sufficient to meet the needs of the MI for future operations? This includes NUMI operations and the remainder of Collider Run II.
- Are the BPM requirements sufficiently documented and understood well enough for the project to move onto the design and implementation stage?
- Are the requirements consistent with the technology choice (EchoTek modules) for the front end hardware and data acquisition?
- Are there sufficient resources to finish the procurement and construction of the BPM hardware by the October shutdown?
- Have the manpower resources for the online software been identified?
- Have the modifications and/or additions to the AD applications programs been specified? Are there manpower estimates for the offline software and have the manpower estimates been identified?

Round Table Discussion and Questions from the Committee:

Following the presentation a round table discussion took place with opportunities for members of the audience and the committee to ask questions and make suggestions. Based on the presentation, the round table discussion, and further communications after the meeting the committee drafted a set of recommendations that we present in this note.

Committee Report

First, the committee would like to thank the presenters for a well thought out and thorough presentation of the requirements, specifications, and design proposals for the MI BPM system. Presenting all of the progress and design proposals for the system would take many days, but the presenters did a very good job of compressing the material and presenting key pieces of pertinent information.

The committee fully supports the need for an upgrade of the Main Injector BPM system. However, we have some recommendations and comments that we hope will be useful. In this section of the report we report our findings and divide these

into three main categories: General Conclusions; Comments on the requirements document; and a list of Miscellaneous Comments.

General Conclusions:

The consensus from the committee is that the MI BPM project is on course for success. The team consists of personnel who are experienced in designing and commissioning BPM systems throughout the accelerator complex. The processing and triggering hardware are based on systems already thoroughly tested in the Recycler and Tevatron. The project has successfully managed a more compressed time schedule relative to the Tevatron BPM project from the time of its approval as a priority funded accelerator project.

Most of the committee's attention was focused on the MI BPM requirements and requirements documentation. It was difficult for us to review designs and schedules because many of the requirements were not explicitly stated in the requirements document. In many of the circumstances the problem was not because requirements were missing, but the requirements were over encompassing and too restrictive for the design. Also, the requirements document included implementation details that the committee thought was more appropriate for a separate design document. Although changes to the requirements document may seem cosmetic at this stage, it allows designers and independent auditors to suggest ways to streamline the system without expert knowledge of Main Injector operations.

Another concern was the coordination with the Main Injector Beam Loss Monitor project. The two projects are scheduled to be commissioned relatively close to each other. There is no mention of the BLM system in either the requirements or design proposals. There needs to be some kind of documented agreement between the two projects, so that resources are conserved and not over utilized (such as rack space).

Details about Improvements to the Requirements Documentation

There was some information missing in the requirements document that was presented or discussed during the review. First, there is a requirement that the system be capable of measuring the tunes of the protons and pbars. This is not explicitly stated in the requirements, but came up in discussion during the review. This should be written explicitly, describing the conditions under which the measurements will be made. Second, there are implementation requirements spelled out in Bob Webber's talk. These requirements should also be explicitly mentioned in the requirements document.

There are a number of general requirements listed in the requirements document that are understood to be too restrictive for practical design and operation. First,

there is an understanding that the system will be blind to beam during the slipping process of slip stacking. This should be stated explicitly in the requirements. Another example of over specification is the requirement that the system be able to measure the position of individual batches. After discussion, the requirement is really that the system be capable of measuring individual batches at their injection or extraction times.

Finally, there were many places where the requirements included implementation suggestions that were not really design requirements. The buffer diagram, for example, is an excellent example of a possible implementation, but it does not illustrate requirements. The appendix of the requirements document is an excellent start to documenting the requirements that the buffer diagram implements. The only thing missing from the appendix is some kind of data lifetime requirement. How long does the data need to remain valid, so that the user can decide whether to save it or not? If the information in the appendix included this information, the buffer diagrams would naturally follow.

Answer to Questions in the Charge

- Are the requirements for the Main Injector BPMs sufficient to meet the needs of the MI for future operations? This includes NUMI operations and the remainder of Collider Run II.

This was not completely clear. We believe that the system will have the necessary dynamic range to measure the standard proton and pbar configurations for 53 MHz and 2.5 MHz. However, the system will be blind during slip stacking when the two batches of beam are slipping relative to each other. However, Main Injector experts did not seem concerned by this.

- Are the BPM requirements sufficiently documented and understood well enough for the project to move onto the design and implementation stage?

We believe that the requirements are understood by the experts and designers. There seems to be an implementation agreement that precedes the formal requirements. However, the requirements should be better documented to allow for independent verification of the design.

- Are the requirements consistent with the technology choice (EchoTek modules) for the front end hardware and data acquisition?

We see no conflict between the requirements and the technology choice.

- Are there sufficient resources to finish the procurement and construction of the BPM hardware by the October shutdown?

The schedule presented to the committee conflicts with the completion of procurement and construction by the October shutdown. However, this seems well understood by the design team, and they are prepared to take the greatest possible advantage of a shutdown should one materialize.

- Have the manpower resources for the online software been identified?

Yes, the changes necessary to the online applications have been identified, and resources have been committed for this purpose. We don't see this becoming a critical path for the project from our understanding of the online requirements.

- Have the modifications and/or additions to the AD applications programs been specified? Are there manpower estimates for the offline software and have the manpower estimates been identified?

We did not perceive that there were any planned changes to the application programs other than reading the new BPM data formats. No requirement for offline software was presented.

Miscellaneous Comments

In our efforts to be thorough we include in this section a list of comments and questions.

- We understand from the presentations that there will be a new paradigm for front end control. The plan is to have new commands programmed into I6 (LLRF Control) to control BPM data acquisition. This sounds like a reasonable plan. However, this application is ingrained into the operation of the Main Injector, and testing the application code and front end code could potentially conflict with Main Injector operations. The time estimates for debugging problems with the front end code need to be adjusted to take this into account.
- The large number of "Flash" TBT buffers and the time to switch between modes may not make sense, for example if each buffer is 512 deep that would be 5.6 msec and we have a mode switch time of 10 msec in and out so the time used by a single flash would be a minimum of 25.6 msec that implies a total time for all 20 such events of .512 seconds which is a large portion of the MI cycle time. This is not a show stopper by any means; I want them to make sure they understand the fraction of the cycle for which they will not have closed orbit data.