

Addendum to the Tev BPM review report:
Comments from individual reviewers

Date: Mon, 15 Sep 2003 11:09:04 -0500

From: Alan E Baumbaugh <baumbaugh@fnal.gov>

Subject: Re: BPM review document

To: Don Edwards <don@dae27.com>

Cc: Mike Church <church@fnal.gov>, Michael Harrison <harrison@bnl.gov>, Dave McGinnis <mcginnis@fnal.gov>, Mike Syphers <syphers@fnal.gov>, Pushpa Bhat <pushpa@fnal.gov>

To All:

I believe that the document is indeed in very good shape. I would only add the following changes, all of which are on page 13:

- 1) I would add the phrase "at least" in front of the 1024 orbit measurements in 2 places
- 2) I would add the phrase "at least" in front of 128 frames of orbit data in 1 place
- 3) I would add the phrase "at least 128" in front of "single frame buffers in 1 place in paragraph 4, there currently is no spec on the number of such frames to be stored. (The current system has 16)

The only other question I had was the linking of BLM to BPM data. The current system definitely links these 2 devices. Both SNAPSHOTs and FLASHes in the BPM also store BLM data. At the time this was implemented, this seemed to be important. (BPM snapshots of 1 ms were disabled since the old slow CPUs could not keep up with both BPMs and BLMs at the 1 ms rate, BLMs would occasionally drop a frame. So the minimum BPM timing was increased to 2 ms so that BLM and BPM frames would remain in sync.) Should this synchronization be part of the requirements, I think it should. However, I am not a user of this data and may not be the best person to ask, I simply state my position based on the current system.

Alan Baumbaugh

Don Edwards wrote:

- > Dear Colleagues,
- >
- > Attached please find a draft framework that I offer as our report on
- > this subject. Your input will be placed in Section 4, and I hope that
- > I can easily place our conclusion in Section 5.

>
> Please note that I have provisionally dated the report as September 17
> of this year. That was the date stated in the message from Pushpa Bhat
> in her request for response. Let's try to get this out of the way
> ASAP, so take a look at the document and let me know what you think.

>
> Also, please copy Pushpa (pushpa@fnal.gov) on your responses so that
> the record is preserved.

>
> Cheers,
> Don

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> -----
> Name: bpmreview.pdf
> bpmreview.pdf Type: Acrobat (application/pdf)
> Encoding: BASE64
> Download Status: Not downloaded with message
>
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Date: Mon, 15 Sep 2003 09:07:11 -0500

From: Mike Church <Church@fnal.gov>

Subject: Re: BPM requirements review - WBS 1.3.4.6.4.2

To: Don Edwards <don@dae27.com>

Cc: Mike Syphers <syphers@fnal.gov>, Dave McGinnis <mcginnis@fnal.gov>, Alan E Baumbaugh <baumbaugh@fnal.gov>, Michael Harrison <harrison@bnl.gov>, John Marriner <marriner@fnal.gov>, Pushpa Bhat <pushpa@fnal.gov>

See comments below

Don Edwards wrote:

> Dear Colleagues,
>
> We are asked to read and comment on the current version of the BPM
> requirements document the location of which has been sent to you by
> Pushpa Bhat. I note that this is the Third Reading. So I would be
> really surprised if there was a whole lot of complaint at this stage.
> Nevertheless, as this review is a milestone, the formalities must be
> observed.
>
> CHARGE TO THE COMMITTEE
>
> 1. Are the requirements described in the document adequate to the
> needs of Run II as they are perceived today and as they may evolve?.
> There is no doubt about the need for measurement accuracy beyond the
> current 0.15 mm limit of the existing analog to digital converters,
> and I think that we all agree that that 20 micrometer level is
> reasonable. Or do we?

Yes. Version 3 of the requirements document is a big improvement over version 1.

>
>
> 2. Are we paying adequate attention to the distant future? The
> present system is 20 years old, and it is my personal conviction that
> the Tevatron must survive for at least another couple of decades. OK,
> we made a mistake or two back in the late seventies.

Yes. Perhaps the next logical step for the BPM system beyond what is being proposed, is a system capable of measuring the position of every one of 1113 possible proton and pbar bunches on every turn. I would not propose this for the sake of an unknown future.

- >
- >
- > That is the end of the Charge. I consider this a very simple exercise.
- > We are asked to conduct a reading of a well-developed requirements
- > document. I ask your comments concerning the document so that I may
- > put together a report.
- >
- > Please note that we are not invited to discuss implementation. In a
- > certain sense, it is possible to dissociate system demand from existing
- > component capability. I find this dissociation very uncomfortable.
- > Fortunately, that goes beyond today's issue.
- >
- > Cheers,
- > Don

From: "Mike Harrison" <harrison@bnl.gov>

To: "Don Edwards" <don@dae27.com>

Cc: "Mike Harrison" <harrison@bnl.gov>; "Mike Syphers" <syphers@fnal.gov>; "Mike Church" <church@fnal.gov>; "Dave McGinnis" <mcginnis@fnal.gov>; "Alan E Baumbaugh" <baumbaugh@fnal.gov>; "John Marriner" <marriner@fnal.gov>; "Pushpa Bhat" <pushpa@fnal.gov>

Sent: Monday, September 15, 2003 1:37 PM

Subject: Re: BPM requirements review - WBS 1.3.4.6.4.2

Hi Don,

I have inserted a few comments

Regards Mike

On Thursday, September 11, 2003, at 07:32 PM, Don Edwards wrote:

Dear Colleagues,

We are asked to read and comment on the current version of the BPM requirements document the location of which has been sent to you by Pushpa Bhat. I note that this is the Third Reading. So I would be really surprised if there was a whole lot of complaint at this stage. Nevertheless, as this review is a milestone, the formalities must be observed.

CHARGE TO THE COMMITTEE

1. Are the requirements described in the document adequate to the needs of Run II as they are perceived today and as they may evolve?. There is no doubt about the need for measurement accuracy beyond the current 0.15 mm limit of the existing analog to digital converters, and I think that we all agree that that 20 micrometer level is reasonable. Or do we?

The RHIC BPM system uses 16-bits which results in an LSB accuracy of ~1 micron (± 32 mm full scale). There does not appear to be any systematic use of this accuracy in most of the day to day operations. There are some specialised activities where it is used, such as a small amplitude tune kicker, but anecdotally I am informed that BPM information is used at the ~10 micron level for routine operations. This experience would indicate that the proposed 20 micron for the Tevatron is a pretty good match for the generic orbit/optics work. If it doesn't cost too much then 16 bits might still be worth thinking about if there no good reason not to do it.

The only other thing I could come up with is whether it might be worth considering a bunch select option so that instead of averaging the whole ring's worth of beam in a given

direction, orbit information is gated to apply only to a specific bunch. With the asymmetric bunch spacing and the high proton bunch intensities then the Tevatron should be starting to approach the scenario of a spread of closed orbits due to non-uniform long range beam interactions; Leo Michelotti's "clothed orbits". The effect is not big but might be relevant at some point. Individual bunch TBT's could also help if a big push is made on brightness. This capability was installed into the RHIC BPM front-ends but has yet to be implemented at the application code level. Since they haven't felt a need to use it, it can't be that important. RHIC has one beam in one pipe however, so it's possible that it might be more important for future Tevatron work.

2. Are we paying adequate attention to the distant future? The present system is 20 years old, and it is my personal conviction that the Tevatron must survive for at least another couple of decades. OK, we made a mistake or two back in the late seventies.

The distant future is by definition distant and therefore unclear. I find your comment persuasive about how it's difficult to imagine anything more complex than counter rotating cogged helices. The operational requirement for both fixed target and collider operation have been quite well established over the past 20 years I don't think they're going to change radically in the future.

I do, however, think Al's comment about whether one should take this opportunity to break the connection between the BPM's and BLM's is reasonable if one has a 20 year perspective.

That is the end of the Charge. I consider this a very simple exercise. We are asked to conduct a reading of a well-developed requirements document. I ask your comments concerning the document so that I may put together a report.

Please note that we are not invited to discuss implementation. In a certain sense, it is possible to dissociate system demand from existing component capability. I find this dissociation very uncomfortable. Fortunately, that goes beyond today's issue.

Cheers,
Don

From: "John Marriner" <marriner@fnal.gov>

To: "Don Edwards" <don@dae27.com>

Cc: "Dave McGinnis" <mcginnis@fnal.gov>; "Pushpa Bhat" <pushpa@fnal.gov>

Sent: Wednesday, September 17, 2003 9:56 AM

Subject: Re: BPM review

The specification is well enough advanced to proceed with detailed design work.

Based solely on the reading of the document, I have some specific comments:

There is no mention of operation of the BPM system in fixed target mode. I assume that there is no requirement to measure beams in this mode of operation.

I am assuming that the 20 um specification has grown out of some understanding of what can be achieved (with reasonable effort). What limits it to 20 um?

It seems to me that it would be useful to require some sort of reasonable reading (not just a sign) out to something more like ± 30 mm.

The "absolute position" accuracy requirement appears to be a requirement on the electronic offset. It seems to me that it would be useful to request a smaller number by a factor of 2 to 3 and that it wouldn't increase the difficulty very much.

The linearity requirement presumably includes the BPM pickup response. The BPM slope at $x=0$ is a function of y . I'd be surprised if the BPM was linear at the level of 1.5% over the range ± 15 mm in both x and y . Is it possible to meet this spec with the current pickup? Over what range? If the system is supposed to make corrections for non-linearities in measured position what should be assumed about the unmeasured coordinate?

The intensity stability is given as 2%, but 2% of what quantity? If it is supposed to mean 2% of the measured position, it is non-sense when the measured position is 0. Why isn't this specified as a fixed number instead of a %?

The table (p23) long term position stability (0.02 mm) disagrees with the number given in the text (0.05 mm/week).

Comment: It appears that the accuracy requirement is driven by the requirement to measure uncoalesced beam in a single turn at an intensity of $3e9$ per bunch to an accuracy of 0.1 mm.

Comment: It appears that there are no requirements on the accuracy of measuring coalesced bunches during injection (only closed orbit measurements are mentioned).

There is no discussion of what part of the beam structure is used to measure the beam position (other than the separation of protons and pbars). There are situations where it could make a difference.

There is no discussion of how the BPM system informs itself about the beam structure. I am guessing that the idea is that it is self triggered, i.e., it digitizes 1 turn of data and then figures out which bunches have beam in them and makes an intensity weighted average. Is that the idea? (This comment is related to the previous comment). The sensitivity of the measured proton (pbar) position to the presence of pbars (protons) is discussed as a problem, but there is no specification given. If the goal is that the proton orbit measurement be unaffected (much less than 20 um) by the presence of pbars independently of the pbar position and cogging, I would suspect that the existing pickup electrodes preclude the attainment of that goal.

John Marriner

Don Edwards wrote:

> Dear Dave and John,
>
> In accord with previous invitations etc etc, please give me your
> succinct reaction to the Tevatron BPM Requirements document and the
> committee charge by close-of-business tomorrow, September 17. I have
> received comments from the other members of the committee.
>
> Cheers,
> Don
>