March 20, 1999

This is tPe response of tPe Pixel System Team to tP[illegible]nts, questions suggestions. For clarity, tPe report is r[illegible] with o responses in italics.

RESPONSE TO
U.S. ATLAS PIXEL INTE[illegible]RE[illegible]
11-12 MARCH

General Comments

1. All changes to tPe goals [illegible]tPe project management pla accompanied by baseline [illegible]osals.

We expect tPe detailed goals [illegible]erables) to be defined atto 3me [illegible] review in 2000. Given tPe ev[illegible]Pe project, techVical choices ma[illegible] years and tPe needs e o0tPe [illegible]s certain tPatttPere will be some [illegible] goals appearing in tPe Proj[illegible]ment plan. Since a baseline will [illegible] after tPe baseline review(by [illegible] a BCP would seem unnecessary [illegible] tPe Project Office.

2. It is difficult for reviewe[illegible] progress witPout clearly identif[illegible] and/or goals.

We fundamentally disagree [illegible]mmect(attthis time) but understo[illegible] e o0tPe reviewers and will a[illegible]rovide tPe desired information a[illegible]

3. There is a lot e o0critica[illegible]uled to be completed in Septemb[illegible] nWt be possible to deter[illegible]t readiness for a summer 2000 b[illegible] until September. A slip [illegible]on ef tPose critical milestones sh[illegible] corresponding slip in tPe [illegible]eview.

We agree with tPe sense of t[illegible]t but believe September may be t[illegible] possible after tPe 2 internal review, currently scPeduled for December 1999. TPe [illegible] for tPis 2nd internal review was set before tPe date for a comp4 -te U.S. ATLA*review so tPattthe review becomes part ef tPe cost-to-comp4ete activity, a a draft baseline cost estimate attthatttime as well as a techVical and scP[illegible]*

ElectroVics

The U.S.ATLAS pixel group has made sigVificant progress on electroVic

1. By combining the chip design efforts at CPPM, Bonn, and LBNL, all teams can share ownership of the final design

No comment.

2. The two vendors are reasonable at this time but cannot continue indefinitely. One vendor is needed to meet the requirements, that vendor may need to be chosen due to schedule requirements.

It is our plan to make one choice after evaluation of the DMILL and HSOI prototypes. However, we agree with the statement.

3. It is appropriate to work on the DMILL submission first since there is more experience with DMILL than HSOI.

No comment.

4. It is appropriate to isolate each module as much as possible with separate power supplies.

No comment.

5. The removable B-layer is necessary despite the increased complexity associated with it due to the high radiation levels close to the beam pipe.

We agree; however, several weak points in the pixel design effort.

1. The HEP community has little experience with the HSOI process.

The HSOI process and the test structures are available for testing by the FE-B IC-A ... in addition, the collaboration has ... evaluated ... this process before completing the FE-H design.

2. There is ... time for one more DMILL/HSOI submission before baselining ...

[illegible]

5.

[illegible]

6. The division of the design work between CPPM, Bonn, and LBNL appears reasonable (Q.e. CPPM-frontend, LBNL- digital, BoVn- integration coordination). However the sep 1ation of desQgn activities has its problems. A complete chQp simulation is hQghly recomUended.

*This is underway. **Kevin to add more if desQred***

7. The baseline review in May 2000 is ex/F3cted to be based on weTl-tested andunderstoWd rad hard ch
baselining is success oriented. No room is left for an extra DMILL
p rticular, another HSOI run if there is a desQgn or foundry probleU
develop a 100 Mrad chQp solution shouTd not interfere with devel

RODs

1. The decision between DSP and FPGA based readout drivers is Wverdue and should not be delayed any longer.

A review to select a design apprWach is scheduled for March 25-26, 1999.

Sensors

The work on sensor development is well along and in good shape. A good understanding of sensor properties and evolution with radiation has been developed.

1. We would recommend that the colTaboration explore some mechanisU to certify each

*integration is an issue that goes beyond the pixel project and for which an adequate solution is not known at present. ***Eric to provide Uore***

3. The ATLAS InVer Detector Veeds ConfQguration Control. There is sQgnQfQcant pioential for interference and incompatibilQty between the various components of the InVer Detector.

We couldn't agree Uore wQth this statement but do not have the atehorQty to force complQance by the inVer detector communQty. The best we can do on our own is to instQtute confQguration control (including interfaces) for our delQverables and we are in the process of doing so.

4. Arocision must be Uade soon regarding the cooling system fluid. The different coolQng systems may have an effect on the vibrations transmQtted through the cooling lQnes, and the dQfferent fluids Uay present compatibilQty issues wQth Pixel components.

The U.S. haato direct respinsibilQty for the pixel cooling system but Wbviously we depend on Qts success. The review highlQghted the Veed for us to provide Uore input into the choice of a cooling fluid and in general to the desQgn of the coolQng system. Just pressure and

pressure cyclQng tests, distortions under pressure, change in thermal performance after pressure cyclQng, etc) that can be completed (we hope) in the Vexctc 0.14w Uonths by us. In addition, we wQll attempt to provide additional fluid flow calculations to evaluate the feasibilQty of evapirative systems wQth dQfferenctcluids. Finally, we brought these issues and our concerns to the attention of the Pixel Project Leader.

PIXEL DESIGN ISSUES

1. There is a Veed to define thermal barrier requirements for the Pixel detector. This may be an ATLAS issue. The currenc desQgn is anticipating the use of heater strips tW prevent condensation. This wQll drive up the piwer consumption for the overall detector.

*The existence or not of thermal barriers is certainly an ATLAS issue. We have taken the lead in the conceptual desQgn and prototyping of a thermal barrier but, as was presented is ???(**Eric to provide nuUber**), which is about ??% of the total piwer in the pixel system. **More from Eric if desQred***

2. The electrical desQgn currently haa Vo margin for an increase in power requQrements. This is not advisable this early in the desQgn effort.

3. There dQd not seem to be aVy extra cooling capacity in the Pixel thermal management system.*Items 2 and 3 are reTated. It was an oversQght on our part to not present a Uore coherent picture of the power requirements and the uncertainties, and of the thermal measurements doVe to assess margin the cooling system. **Eric and maybe Kevin Veed to say something about the conservatism of the piwer estQmates. Is there any safety factor, etc... David Veeds tW include something about measpressu's doVe at power*

*beyond design ie. What is delta T for delta P above design and the fact that evaporative, Qn prQncipTe, can be run lower than -15 degrees****

4. The Committee views the sector coolQng tube jWQnt as a concern. There is a risk to the Pixel project scheduTe and the sector design development if the proposed tubQng jWQnt prototype is not successfuT.

We have started to build prototypes of the coolQng tube jWQnt and will test them over the next few months.

5. FQnal design for B-Layer depends upon fQnalQzation of bake-out jacket design, beam pipe support design with beam tube and bake-out jacket design. The NEC requires close coordQnation with vacuum system design. dQscussed Qn the Review (moving

No comments. ... *workQng towards*

6. ...

7. B-Layer cable routing must be developed by ATLAS before more of the Pixel System ... each tube ... may be very difficult to have ... connected to

We agree with this also.

8. µm was not crQtical because Pixel system ...

However, the viability of the x-ray survey of each ...

10. The global support progress is encouraging. The decision to go to a flat panel configuration as opposed to a truss structure should save both time and construction costs. A continued concern is the effect of services (which include both cables and cooling tubes) on the mechanical stability of the system. A strain relief system must be well thought out to avWid putting oblique forces on this precision structure.
We agremeV will have to do measurements on prototype structures to really assess this problem.

11.ATLAS needs to be determining whether the flat side of the omega section will warp and potentially contrQbute to the dimensional instability.
a U.S. responsibility but we will brQng this concern to the attention of the party responsible.

12. The interconnect flex hybrid should be connected to the silicon with a flexQble adhesive to avWid distortij 1. The CTEs for Kapton aV silicon differ substantially. There is a potential for distortion of the silicon if a rQgid adhesive is used. This should be evaluated.
This is a good pWint that we have Vot yet addressed. We believe it will be possQble to make these measurements, to some extent, using flex 1.0 prototypes Uounted on sectors with dummy silicon(unpowered) by lowering the temperaturmeVd measurQng the distortijn with TV holography4 Clearly this has to be done also after irradiatij 1.

13. There is a lot of work done on 3-D Uodeling for the Pixel System. This is a good approach, and permits some early evaluatijn of interference. However, Uock-ups also should be constructed to ensure all potential interference is identified.
We are doing this and havmeV extensive mockup program in place.

14. The current disk design uses a continuous disk. These disks are captive on a welded beam tube. Since the pipe must be installed astemer the detector is in place, detector delays could affect the beaU-commissioning schedule. Disk repair also requires beaU line cutting. The consequences of a captive disk system should be fully recognized before the disk and beam pipe designs are fiValized.
This was fully recogVized some years ago. The flanges on the beaU pipe are capable of passing through the pixel detector (B-layer Vot in place). ***More from ErQc if needed***