Responses to the Layer 0 Module PRR recommendations
12/16/04

1. We recommend that the project reduce the number of hybrids per shipment both from NXGen to Fresno and between Fresno and FNAL so that single-shipment loss cannot jeopardize the project as a whole. We also urge the project to consider sending someone to NXGen while the final batch of hybrids is fabricated, as has been done for all the prototype and preproduction runs.

We agree with the committee. The last shipments from Fresno to KU and Fermilab were split into smaller batches (15 hybrids max). Ray Hall will go to NXGen for the last production run of 50 hybrids before Christmas.

2. We feel it is imperative that the additional tooling identified to facilitate the production (sensor Kapton wrapping fixture, sensor/flex/hybrid alignment and bonding tools) should be fast-tracked so that additional pre-production parts can be fabricated with this tooling prior to the start of production. These parts could also be used for training of additional personnel for assembly and bonding which will be necessary if the project decides to move to 8 module/week production rate. We recommend that D0 follow their plan to fabricate additional tooling that would allow for up to 8 modules to be produced per week. One of the sets of tooling should be designed to accommodate the out-of-tolerance hybrids.

Additional tooling will be fast-tracked through shops. Wire-bonding fixtures were submitted to a Fermilab shop, have been delivered, and await QC. A request for additional tooling (cable-hybrid gluing fixtures) to increase the module production rate from four per week to eight per week was submitted December 3, 2004 to the Michigan State University shop, which provided the earlier fixtures. We hope for delivery in early January. Detailing of the sensor wrap-around fixture remains to be completed. We expect to submit those fixtures to a Fermilab shop. Uniformity of out-of-specification hybrids will be re-evaluated to understand what fixturing changes should be made to accommodate errors in hybrid cut locations. Initial testing suggests that shims at fixture pins will adequately correct for misalignment, yet allow variations in cut location to be accommodated.

3. Wire bond protection (bumpers or encapsulation) should be included as a part of module production. We recommend that this work be done prior to the final tests that will be used to grade the modules. This is a critical operation that could damage wire bonds. The additional adhesive on the active sensor surface could affect final noise performance of the sensor modules as well.

Bumpers are included in the design to protect wirebonds as well as space cables off of the detector surface. All of the bond protection bumpers can be placed and tested before installation. Some of the cable spacers are not compatible with the vacuum pick-up used to place sensors on the support structure during installation and need to be placed after installation. None of these are near wirebonds. The effect of bumpers has been tested both on prototype modules and on the modules installed in the electrical test structure and no effects have been observed.

4. We recommend burn-in be performed at the maximum anticipated operating voltage of 300V. A system should be implement to ensure the integrity of the burn-in and testing data, i.e. that the critical data is backed up daily.

We have accepted the committee's recommendation to increase the burn-in bias voltage to 300V and have already applied it to modules available for testing (118). The integrity of the burn-in and testing data has been ensured by keeping copies of all essential information on two computers:

local PC and d0server4(6), which is backed-up daily. The information kept includes:(i) V-I curves, (ii) plots from quick-functionality tests, (iii) burn-in summary ps files, and (iv) relevant web pages. Summary files are copied to the d0server4(6) immediately after being made. Histogram files are only kept on the local PC - their volume (for 10 modules and 25 hybrids burned in) exceeds 7Gbytes. It is our understanding that this kind of detailed information had not been backed up for the Run 2a project.

5. We believe that the project should consider placing an order for 50 of the second pitch adapter type from ATT. If these are of higher quality (consistent high bond pull strength) and are available, they should be used in place of the pitch adapters from TFT Seigert.

The orders for both types have been placed. We note that the company only provided bonding samples and have not shown that they can provide parts with the necessary electrical and mechanical quality. The TFT Seigert parts meet our specs, bond consistently and can be used in the final detector.

6. We suggest that the project consider employing independent personnel for visual inspection at each stage of production, i.e. that people are not inspecting their own work. The concern is that people tend to concentrate on areas where they had difficulties and may gloss over other regions in their inspections.

We will do this whenever possible.

7. We recommend that the project consider development and implementation of a new test in order to certify the effectiveness of the grounding/shielding scheme. A parameter to be monitored is the noise induced occupancy while running the SVX4 ASICS with the nominal operating conditions (sparse mode with the nominal thresholds). Such occupancy can strongly degrade the performance of the modules if above a certain value by inducing additional read-out time. This parameter should be closely monitored while installing the modules on the carbon fiber support structure so that in-situ corrections and or improvements can be applied.

8. We recommend that any systematic effects, no matter how minor, be thoroughly investigated. It is our opinion that this should be a higher priority than increasing the production rate. We further suggest testing with faster rise time to increase significance (magnification of noise).

Readout occupancy indeed is an important parameter to evaluate the noise perfomance of the prototypes and final device. We are progressing well with the mounting of modules on the prototype support structure. So far 5 modules are mounted on the structure. After addition of each new module we are performing a set of measurements to understand the performance and changes with respect to the previous configuration. Data corresponding to different settings of bandwidth, preamp bias current, integration time, pipeline cell location with respect to the preamp reset and with respect to the calinject signal is recorded in the read-all mode. During these tests we also try different grounding configurations and sensor bias voltages.

These measurements give enough information to model the occupancy for different assumptions about the threshold. We verified during the burn-in tests that the readout in the sparse mode is functioning correctly so acquiring this data in read-all mode should be adequate. We are planning to perform measurements in the sparse mode with the prototype support structure as well. Recent measurements can be found in:
http://d0server1.fnal.gov/projects/run2b/silicon/www/status_l0_mount1.ppt