HYTEC Monthly Progress Report – Submitted to SLAC

November 30, 2000

1. Monthly Management Review

Monthly progress report submitted November 30, 2000 for work performed by HYTEC.

2. Schedule

The detailed HYTEC schedule was delivered to Tom Borden @ SLAC in Microsoft project format, to help define direction and responsibilities through PDR. Key dates and milestones were taken from this detailed schedule and consolidated in another Microsoft project schedule for the purpose of tracking HYTEC progress. These schedules are available on the HYTEC/GLAST web site.

3. Tracker Tower Level Modeling

Standard Tray Modeling to Determine CTE Effects of the Al Core

There is some concern that the FE representations used in sandwich structures cannot adequately simulate the combined face sheet and core CTE. This deficiency could lead to errors in evaluating thermal stresses induced by temperature fluctuations. In particular, we are concerned that the honeycomb cores may play a more dominating role in the overall sandwich CTE, where thin face sheets are bonded to relatively dense cores. With this potential deficiency in mind, we have generated a FEM and closed-form expressions to identify missing engineering parameters for use in sandwich structure models. This modeling effort is expected to be completed early December and may be compared to test results performed at a later date.

Bottom/Top Tray Modeling

Modifications to the top and bottom trays are being considered, which will have a direct impact on these tray frequencies. For this reason, we have begun modeling the bottom tray to determine the effects on stiffness if the core is reduced to ½ the thickness of the standard trays. Bottom tray modeling will be completed in December.

Tracker/Instrument Modeling

A tracker/instrument model has been updated to include the most recent tracker tower design concept, mounting configuration, and grid stiffness/mass. Results have indicated that including tower clips in the tower-to-tower design of the tracker would cause excessively high loads in the tower sidewall fastener locations. For this reason, it has been decided that tower-to-tower clips would not be included in the design of the tracker. There may be a need for soft visco-

elastic materials between towers to damp the energy produced from launch vibrations, however this will not be assessed until after the mini-tower qualification testing.

Due to recent comments regarding HYTEC's role in the design process, this instrument model has been archived and will not be used in further analyses. To ensure continued progress and continuity with other subsystems, HYTEC will require specific design requirements that detail the tower interface with the grid support structure. This information should include minimum frequency, deflection (static and RMS), loads, mounting configuration, and boundary conditions (fixed base vs elastic foundation). These design requirements will need to be defined during the month of December and provided by the systems engineering group at SLAC.

4. Tracker Documentation

Update Dimensions

All closeout trays were modified to reflect the 368.5 mm envelope. The distance from the closeout wall outer edge to the silicon was set to 1.6 mm.

CAD Modeling of the Top and Bottom Trays

Design concept modifications were incorporated into the CAD model to reflect changes discussed at the engineering meeting at SLAC. This change reduced the part count for the tower and mirrored the top and bottom trays.

Drawing Package

Drawings are being updated to include design modifications.

A recent decision to have all E/M and flight hardware trays fabricated in Italy has led to the decision to use metric as the primary dimensions on all drawings and English as secondary dimensions. This is currently being incorporated into the drawing package and is expected to be completed in December.

The drawing package will continually be updated and available on the HYTEC/GLAST web site.

5. Tracker Tray Closeout Development

Particulate Pollution Issues

Several tests have been planned and will be performed during the month of December. These test will evaluate the bond strength of the coating options to help identify an acceptable coating to reduce carbon particulate pollution.

Carbon-Carbon Material Procurement

An order has been placed to procure carbon-carbon material for all prototype testing at HYTEC and SLAC through PDR. The first lot of material is expected mid-December and the remaining material is expected mid-January.

HYTEC has been asked to provide additional material to support the SuperGLAST prototype efforts at Pisa. Four prototype frames will be required

for Pisa. An RFQ has been issued for this material and is expected December 1st. The material will be ordered early December.

The total cost of carbon-carbon material is $9,400 for the HYTEC and SLAC quantities. Approximately $900 of this total has not been budgeted in our cost proposal.

Closeout Frame Development

The closeout frame design is continuing to progress. Various corner joint design concepts are being investigated to improve the strength of the closeout frame, inserts are being studied to improve assembly and assembly features have been included to provide alignment fiducials during assembly.

6. Face Sheet Material Selection

Face Sheet Material Purchase

A purchase order was placed to procure all face sheet material for prototype testing through PDR at HYTEC, SLAC and Pisa. Twenty-six, 4-ply face sheets for the standard tray prototypes and twelve, 6-ply face sheets for the SuperGLAST trays were ordered. The order includes materials, lay-up, processing and machining to net shape (for most of the panels). The material is expected to be delivered on December 27. HYTEC will split the orders and deliver the appropriate materials and quantities to the appropriate locations. The total material purchase was $31,480, which includes $17,280 more than HYTEC has budgeted for.

7. Tracker Tray Sidewall Design

Material Property Testing

Sidewall prototypes, YS-90A and P30 C-C, were delivered and cut into a number of samples for thermal and mechanical testing. Samples included testing of mechanical properties (strength and modulus), thermal properties (conductivity in three orthogonal directions), and fastener pullout and shear-out testing. The mechanical and thermal property testing will be performed by outside labs to the appropriate ASTM standard. Several vendors were contacted and quotes were received.

Orders have been placed with two separate labs to perform the mechanical and thermal property testing. Samples were delivered late November. Mechanical test results are expected around December 15, with thermal test results the following week, December 22.

Pullout and shear-out testing of the sidewall fasteners/inserts will be performed in-house. A fastener pullout test fixture has been designed and is currently being fabricated. It is expected to be completed mid-December with pullout testing following immediately. A fastener shear-out test fixture is currently under review and will be fabricated early December. Shear-out testing will begin immediately following delivery of the test fixture.

Sidewall Mechanical Fasteners/Inserts

The sidewall attachment fasteners and inserts are being investigated. Fastener failure limits have been calculated and torque values have been calculated. A recent decision to use metric dimensioning as the primary dimensions on all drawings requires the fasteners to be re-sized.

8. Tracker Meetings and Tracker Technical Discussions

Engineering Meetings

Erik and Steve met with Tom Borden and Martin Nordby at SLAC to discuss tracker related issues and the bottom mounting configuration.

Vendor Meetings

Erik, Steve and Tom met with PCI to discuss tray assembly issues. This included bonding unbalanced face sheets with a core to form a balanced sandwich structure. In addition, discussions about the assembly procedure were discussed.

Weekly Meetings

HYTEC participated in all weekly tracker technical meetings with SLAC and UCSC, during the month of November.

9. Tower Clearance & Alignment and Silicon-to-Tray Alignment (Not in Statement-of-Work)

Tower Clearance & Alignment

Progress has been made to understand and identify machining and alignment tolerances for tray/tower fabrication and assembly. The alignment envelope for the tower is a 400 μm square boundary surrounding each tower, with 1 mm of clearance on the top of the tower for tolerance stack-up. A decision was made to limit the height of each tower to 626 mm above the grid interface plane.

Tower clearance can be achieved by holding a 0.005" (i.e. +/- 0.0025" for tray height) profile tolerance on the tray height (including spacer blocks in corners) and +/- 0.001" positional tolerance on the tray corner post hole pattern. Projection tolerances on the corner post holes are being investigated to understand and determine machining tolerances to sufficiently align trays/towers.

All tolerance analysis is being performed using the SRSS (square-root-sum-of-squares) method to account for the random behavior of machining tolerances and eliminate being too conservative, which will result in very tight (and expensive) tolerances.

Silicon-to-Tray Alignment

The alignment requirement, as decided at the November engineering meeting at SLAC, for tray-to-tray alignment of the SSD's is not to exceed 50 μm. This assumes that the SSD's to the aramid converter board and the converter board to the tray to each be ± 10 μm. This alignment requirement can be achieved if the projection tolerance of the corner post holes is not significant. The decision was

made here to use bonded bushings in the corners to ensure the location of fit is acceptable to meet alignment requirements.

10. SuperGLAST Tray Analysis (Not in Statement of Work)

A simple analysis was performed to determine the minimum face sheet ply thickness and core density for the SuperGLAST trays. The analysis showed that an quasi-isotropic 6-ply's lay-up was required for the SuperGLAST face sheets to provided adequate stiffness for the trays to avoid contact with adjacent trays. The core density must also be 3.0 lb/ft^3, minimum.

11. Bottom Tray Attachment to Grid (Not in Statement of Work)

A tower attachment concept was proposed to Tom and Martin at SLAC, which would help minimize the CTE mismatch issue between the tower and aluminum grid. The concept was accepted and has been under investigation. A flexure mount configuration and flexure design concept is near completion. The design is currently being analyzed to determine the effects on tower stiffness and will be available in early December to be incorporated into the instrument model for systems level analysis.

12. Tray Assembly (Not in Statement of Work)

Tray assembly fixture concepts are being designed. These fixtures support bonding of the inserts, bonding of the closeout frame and bonding of the core and face sheets. Discussions with PCI indicate that the assembly procedure will be acceptable to produce the dimensional stability required. The concept has not progressed beyond conceptual, however will be scrubbed during the month of December.

13. HYTEC/GLAST Web Site (Not in Statement of Work)

A HYTEC/GLAST Database site is now available on the web for the purpose of sharing information generated by HYTEC with the collaboration. This site will continually be updated to include information generally shared through ftp or e-mail.