HYTEC Monthly Progress Report – Submitted to SLAC

March, 2001

1. Monthly Management Review

Progress Report

Monthly progress report submitted May 7, 2001 for work performed by HYTEC during the month of March.

HYTEC Funding

HYTEC funding issues were resolved during the month of January. Funding has been secured through FY'01 (September, 2001).

2. Tracker Tower Design

Tracker Tower Alignment

Simple tolerance tests were performed to verify the minimum tolerance required to ensure engagement of the countersunk screws. Based on test evaluation, a maximum allowable tolerance of 0.005" will allow fastener engagement, assuming maximum fastener size and minimum hole size. Additional clearance and engagement tolerance can be achieved by enlarging the size of the countersunk screw holes to allow engagement between the sidewalls and closeout frame in the even the tolerance is greater that 0.005". This was verified through coupon testing.

3. Tracker Tower Level Modeling

Tracker/Instrument Modeling

The TKR tower finite element model is being updated to include a level of detail that can be used to fully understand the mechanical/thermally induced stresses in the tower. Details of the fasteners, geometry and material properties will be included that best represent the present TKR tower design concept. This model will be used to evaluate the stiffness, strength and thermal issues still unresolved at the tower level. This model is expected to be completed in April.

A summary report of the FEA will be written and available for PDR. This report will summarize current FEA predictions.

4. TKR CAD Modeling/Drawings

Solid Model

The TKR tower solid model is being updated. CAD models of the MCM cables have been received from SLAC and were incorporated into our model. This is to verify clearances and commonality with SLAC models.

Drawing Package

According to Tom, there are considerations to abandon the CyberDocs tracker program. For this reason, HYTEC has not been including drawings on the CyberDocs network, but simply using numbers retrieved from this site. After the drawing package has been completed, or the SLAC system has been finalized, HYTEC will submit an electronic version of the drawing package to SLAC DCC.

5. Tracker Tray Closeout Development

Particulate Pollution Issues

Test plans are being reviewed to determine the most effective method of quantifying wear on the closeout coating and determining a sufficient coating thickness.

Carbon-Carbon Material Procurement

The final shipment of C-C material has not arrived at HYTEC. The material delivery was delayed due to insufficient density of the plates. The material was put through an additional densification process, which delayed the delivery of the material. The latest delivery date is scheduled for early April.

Closeout Frame Development

The closeout wall drawings, 102-TKR-12-3011 and 102-TKR-12-3021, were released and placed under revision control. An RFQ was sent to four shops to understand both the cost and the shops ability to fabricate these parts to the tight tolerances called out on these drawings. Only one company responded to the RFQ, Graphite Machining Services Inc.

GMSI believes that the machining tolerances called out on these drawings can successfully be maintained. A sample of carbon-carbon material was given to them to experiment with to determine the true tolerance capability of their machines using this material.

During test machining, it was discovered that the C-C material is moving as a result of micro-yielding from machining stresses. This will be investigated in greater detail during the month of March.

Closeout Wall Threaded Inserts/Fasteners

Pullout testing of 6061-T6 aluminum was performed to determine the pullout strength using aluminum inserts. The strength of 6061-T6 aluminum was about a factor of five times higher than required for the sidewall pullout loads. The results of these tests concluded that aluminum was an acceptable material for the closeout wall threaded inserts. Tests are planned for April to verify that

mechanical cycling of thread installation and galling are not issues to be concerned with.

Fastener pullout tests were performed on the M1.6 threads to determine if the pullout strength of these threads in the C-C was sufficient to carry the load of the MCM's. It was shown that the pullout strength of the threads cut directly in the C-C material is sufficiently strong enough to support the load of the MCM. Therefore, the metallic inserts were removed.

Additional coupon level testing was performed to investigate the bond strength of 9309 at elevated temperatures. The results indicated that the glass transition temperature was not exceeded and the bond strength was not degraded as a result of being taken to elevated temperatures.

Closeout Frame Prototyping and Testing

Joint testing was performed on the closeout mortise and tenon joint. Two load directions were studied to be sure that there was sufficient strength to accommodate handling of the closeout frame without face sheets and core bonded as a sandwich structure to the closeout frame. The joint was tested in tension, pulling the tenon axially away from the base material, and again in bending, where a lateral force was applied to the joint to cause an interlaminar shear failure. The joint configuration was sufficient to warrant additional testing.

6. Face Sheet Material Selection

Face Sheet Material Purchase

The face sheet material has been completed by PCI and a portion of the material was delivered to HYTEC. All of the 4-ply face sheets, with the exception of six uncut face sheets were left at PCI for tray prototype fabrication. The remaining six 4-ply face sheets and all the 6-ply face sheets were delivered to HYTEC for distribution.

The face sheets were visually and dimensionally inspected for quality. All face sheets were of acceptable quality.

Face Sheet Material Distribution

Ten of the twelve 6-ply face sheets were shipped to INFN on March 26th.

Face Sheet Material Performance

A performance issue was raised with the tensile tests performed by PCI on both the 6-ply and 4-ply face sheets. The measured elastic modulus of the 6-ply face sheets was 13.7 Msi and of the 4-ply face sheets was 11.1 Msi. The calculated elastic modulus for both laminates was 14.8 Msi based upon classical laminate theory. Discussions with PCI and Nippon Graphite concluded that the measured values were correct, however they are very dependent upon laminate thickness, fiber volume fraction and coupon width. With this information, the tray finite element analysis was performed again to quantify the end effect on stiffness. It was shown that the standard tray stiffness would be sufficient to keep the fundamental frequency above the desired 500 Hz requirement. The 6-ply face

sheets used on the SuperGLAST trays is not, however, sufficiently stiff to provide the required 500 Hz fundamental frequency. The face sheets were accepted as is for the sake of schedule (this appears to be a no-fault situation). INFN will need to evaluate the SuperGLAST trays to verify the stiffness and rms response to the random vibration environment.

7. Tracker Tray Sidewall Design

Material Property Testing

A summary matrix of the sidewall coupon testing was written to assess and select the appropriate sidewall material. P30 carbon-carbon and YS-90A Gr/Ce were among the two candidate materials. Based on the results of coupon testing, the Gr/Ce sidewall material was selected because of its superior strength to P30 C-C. The cost difference for the Gr/Ce was not a factor in this selection. The two materials had comparable thermal performance making this an easy decision.

8. Contact Resistance between Sidewall and Closeout

Nothing to report.

9. Tower Clearance & Alignment and Silicon-to-Tray Alignment

A summary report of the tower-to-tower clearance and tolerance stack-up analysis has been completed and submitted to SLAC. This report summarizes the required maximum closeout flatness, corner post hole location and projection tolerances required to meet the maximum misalignment. The results indicate that the tolerances are tight, however they are not out of range of today's machining capabilities. These will be transferred to the closeout wall drawings in April.

10. Top Tray Design

The top tray design configuration does not allow for cable termination. Currently, the cable termination will be done above the towers and not on the top tray. For this reason, the top tray configuration has been redesigned to match the bottom tray configuration to reduce the number of unique parts. This design approach reduces machining costs and assembly errors.

11. Bottom Tray Attachment to Grid

The bottom tray configuration matches the top tray configuration. The blade flexure design has not advanced beyond conceptual at this time. A "Cotherm" product, or equivalent, is being considered for the thermal interface between the bottom tray and the grid. This interface will transfer all the heat generated by the tower into the grid. For this reason, this interface must be very efficient, while compliant to minimize mechanical stresses. These issues will need to be worked out during the next few months.

12. Tray Assembly Tooling

Graphite Tooling Procurement

The graphite assembly tooling was received in March. Inspection reports provided by the vendor show that the tooling was out of tolerance, per the

drawing. Investigations revealed that the tolerance error was the result of a misinterpretation of the drawing GD&T (no-fault situation).

This lead to a visit to GMSI in Tempe, Az to discuss the approach to tooling design. The tooling concept was revised as a result of this visit which proves to be very favorable in providing the appropriate tooling. GMSI understands what is required and the alternate tooling will be purchased in April.

Tooling Concept Testing

The tooling concept, as it was initially designed, was tested by assembling a closeout frame mockup at HYTEC. Although there were some tolerance issues with both the mockup closeout frame and the tooling design, the concept proved to be acceptable.

13. Vendor Tours

Graphite Machining Services Inc

A trip was scheduled with GMSI to discuss problems associated with machining the graphite tooling used to assemble closeout frames. The visit included a tour of the shop area, which housed four very large CNC mills, a number of grinders and standard drill and lathe machines. The mills have been used to assemble a number of complex and precision pieces. Overall, the shop appeared to have the machining capability to perform the machining tasks as required.

14. Tracker Meetings and Tracker Technical Discussions

Weekly Tracker Meetings

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

Weekly Instrument Meetings

HYTEC has participated in all the weekly instrument integration meetings with SLAC to discuss Tracker to Grid integration issues.

Engineering Meetings

Erik scheduled a trip to SLAC to discuss tracker design issues with SLAC engineers. This meeting was very productive.