

## **LAT I&T Peer Review, 2003**

The Peer Review for the LAT I&T was carried out on March 28, 2003 as planned; see [http://www-glast.slac.stanford.edu/IntegrationTest/CDR/it\\_peer\\_review.htm](http://www-glast.slac.stanford.edu/IntegrationTest/CDR/it_peer_review.htm) for the agenda and presentations. The meeting was attended by Review Committee members, GLAST support staff from GSFC, and representatives of the GLAST Project Office and the LAT IPO. The Review Committee consisted of Robert Marcellini (chair), Bernard Graf (co-chair), Joe Bolek, Ed Shippey, Tune Kamae and Mike Menning. The I&T Team was fully represented with presentations by Elliott Bloom and Brian Grist.

Overall, the level of detail was at or near CDR Level and the presentations were well-planned and clear. However, in addition to the RFA's the committee reflected on

- 1) schedule concerns with no contingency identified. (subsystem schedules need to be resolved at the subsystem level)
- 2) documentation should include all processes and procedures
- 3) sufficient mandatory inspection points need to be defined.

The following represents a summary of the Review Committee Caucus, regarding the five questions posed in the charge to the committee

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- 1) Is the design maturity, qualification and verification planning near CDR level?  
Yes
- 2) Has the subsystem identified open design issues and established appropriate resolution plans to ensure closure?  
Yes – except for 2 issues out of their control i.e. availability of subsystem EM and Flight hardware and appropriate resolution of the Beam Test Plan.
- 3) Is the subsystem near readiness for manufacturing?  
Yes- They are “very ready” in some aspects but some items are waiting subsystem resolution.
- 4) Has the subsystem identified open manufacturing issues and established appropriate resolution plans?  
Yes- Some residual concerns relate to harness/cable installations and tie downs.
- 5) Are there other issues that should be addressed?  
Other than these captured in RFA's the following have been identified:
  - 1) Perform an Electromagnetic Background measurement of the Test Area.
  - 2) Develop criteria for re-work
  - 3) Develop a plan for science team support to evaluate problems and resolve anomalies.

We recommend this Peer Review be accepted as successful.

R. Marcellini, Chair  
B. Graf, Co-Chair

## **I&T Peer Review, March 28, 2003**

### **REQUESTS FOR ACTION – E. Bloom**

#### **1. I&T: E. Shippey**

REQUEST: What are I&T interfaces with other organizations during project?

REASON: What interfaces/reviews are in place to interface with subsystem design/fab groups to assure I&T needs are met?

How are observatory I&T needs addressed?

Is there any interchange between personnel of I&T and subsystem groups?

RESPONSE: 1) All subsystem managers are required to attend a weekly CAM meeting called by the LAT Project Manager, and an engineering meeting Chaired by the LAT Chief Engineer. The I&T Manager's signature is required on all Subsystem-LAT ICDs.

2) The I&T Manager and Engineer participate in the Observatory I&T working group Chaired by the Spectrum Astro I&T manager; the SIIS also has a working group where the I&T Engineer is the LAT point of contact.

3) The Online Dept. Head holds weekly meetings with representatives of the Subsystems to discuss EGSE issues. The IFCT Dept. Head has just begun weekly meetings with representatives of the Subsystems to discuss EM integration issues. This meeting well before flight hardware arrives.

#### **2. I&T: E. Shippey**

REQUEST: Will MGSE be compatible with S/C for integration of LAT with S/C?

REASON: I had heard in previous conversations that there might be interferences with the S/C that might affect the LAT MGSE.

RESPONSE: I&T is planning to have MGSE available at Spectrum Astro for observatory integration. This MGSE will allow us to place the LAT on the S/C without interferences. The S/C-LAT IDC should ensure that such interferences will not occur.

#### **3. I&T: E. Shippey**

REQUEST: Confirm that vertical installation of X-LAT plate doesn't present any problems such as stresses, deformation, etc.

REASON: Meet concerns expressed by GSFC/Swales

RESPONSE: With new design of LAT Integration MGSE, there is no I&T Requirements to install the X-LAT plate vertically. However, the I&T MGSE LAT Rotation fixture would allow vertical installation if that was required.

#### **4. I&T: E. Shippey**

REQUEST: General concern about coordination of subsystem design with I&T requests, e.g.:

- Need for breakouts
- Keyed connections
- Length/interchangeability with cables
- Wire gage/physical strength
- Protection of equipment during I&T

REASON: Concerned that subsystem design reflects special needs of I&T.

RESPONSE: I&T is coordinating with Electronics on these issues. There will be break out boxes and extender cables. According to electronics, given the design of the connectors they cannot be keyed. We will use labels and procedures to insure correct mating. In addition, connectors with differing functionality have different form factors. The gage/physical strength of the cable are considered adequate for the LAT application. All multistrand cables will be sheathed. I&T will protect equipment during installation.

#### **5. I&T: J. Bolek**

REQUEST: Carefully control and test electronic units for EMI/EMC compatibility. Radiated emissions and radiated susceptibility corrective actions may require additional harness dressing.

REASON: There is little room available for modifications to harnesses. EMI/EMC deficiencies may require additional harness and connector dressings after integration.

RESPONSE: EMI/EMC testing is done during the EM2 design phase of the electronics boxes. This is done by the electronics subsystem. Cables will be removed for rework if needed.

#### **6. I&T: J. Bolek**

REQUEST: Make provisions for troubleshooting electronics. Provisions should include BOBs and cable extenders so that units can still be electrically interconnected during troubleshooting procedures.

Key connectors so that connectors will be properly mated

Wire harnesses and connector/harness interfaces must be tightly controlled. This process should be clearly defined for the harness manufacturing technical staff.

REASON: The installation of the electronics is sequential in nature and somewhat confined by design. There is risk to schedule if provisions are not made to have cable extenders and BOBs available.

There is risk to hardware if connectors are incorrectly mated. Keying the connectors reduces this risk.

The wire harnesses are located in confined spaces. This limits the amount of room available. Things like harness bend radii, connector shielding, etc. must be considered and controlled.

RESPONSE: I&T is coordinating with Electronics on these issues. There will be break out boxes and extender cables. According to electronics, given the design of the connectors they cannot be keyed. We will use labels and procedures to insure correct mating. In addition, connectors with differing functionality have different form factors. The “harness” will be laid, cable by cable, in place. This will be done via a preconstructed plan developed by I&T and Electronics.

## **7. I&T: R. Kolecki/B.Graff**

REQUEST: Are connectors keyed to specific locations?

REASON: Given the number of connectors on the LAT instrument (and mating sequences) the possibility of incorrect electrical connection during I&T is high. Keyed connectors reduce the risk inherent with numerous connectors similar in size/design & ID's with only a serial number.

RESPONSE: According to electronics, given the design of the connectors they cannot be keyed. We will use labels and procedures to insure correct mating. In addition, connectors with differing functionality have different form factors.

## **8. I&T: B. Graf**

REQUEST: Investigate/consider how troubleshooting will be done with BOB, cable extenders, etc.

REASON: Tight tolerances make the use of troubleshooting equipment difficult.

RESPONSE: We plan to use BOB and extenders, if TEM connectors will be accessed some disassembly will be required. According to electronics, the connectors used in the LAT during I&T can mate/demate 10 times.

## **9. I&T: M. Menning**

REQUEST: When will the Flight Software Test Bed be placed under Configuration Control?

REASON: To maximize the utility of this tool, thru the GLAST life cycle, the test bed must be functionally identical to the flight unit.

RESPONSE: Two months before the Integration Readiness Review (IRR), there will be a subset of the test bed under configuration control in order to do EGSE validation. The full software test bed will be under configuration control before the first LAT comprehensive test.

## **10. I&T: R. Kolecki**

REQUEST: What timeframe is the Beam used for testing available? I&T presentation stated that beam was off during the summer. What test mitigation is planned?

REASON: With a tight schedule, any slips in hardware fab and component delivery to SLAC can affect I&T schedule. If beam testing needs to be done in June to August timeframe (instead of April/May) what is impact on mitigation?

RESPONSE: The beam supplied for the LAT beam test by SLAC is an off project cost. The project has been told by SLAC's Associate Director of Research that the beam will be available for the LAT beam test as required. If we need to use the beam in the summer, SLAC will incur additional off-project expenses as compared to the currently scheduled beam test time. NB: It is not formally an I&T responsibility to guarantee that the beam is available as promised by SLAC. This is a negotiation between the LAT project office and SLAC.

## **11. I&T: B. Graf**

REQUEST: Need an EGSE/MGSE verification plan (including both SLAC and NRL) prior to CDR.

REASON:

RESPONSE: Both EGSE and MGSE verification plans are in our documents: LAT-MD-01462- MGSE, LAT-MD-01563- EGSE. These docs are currently in draft and are planned to be released by CDR.

## **12. I&T: E. Shippey**

REQUEST: Why are you using random vibe for developing "signature" and subsequent verification of results of sine vibe?

REASON: Normal practice at GSFC it so use low level sine sweep. Correlation of before/after is easier.

RESPONSE: For the vibrations tests of the LAT I&T will follow the requirements specified in LAT-MD-01196, the LAT Dynamics Test Plan. This document is held by SE.

### **13. I&T: E. Shippey/B. Graf**

REQUEST: By the LAT CDR, SLAC should be prepared to address their needs/expectations/plans during observatory I&T. This should include “expected” compatibility of EGSE, MGSE, LAT testing plans, facility requirements (cont. cont.environment).

REASON: I think this is extremely important for a successful CDR

RESPONSE: Many of these issues were addressed in a special section in our peer review. With our current knowledge of the Observatory integration plan we cannot proceed much further. I&T has been working with the S/C vender in the observatory I&T group to coordinate issues. The S/C-LAT ICD is addressing many of these issues, and is held by SE and the Project Manager.

### **14. I&T: M. Lovelette/B. Marcellini**

REQUEST: Perform a muon survey at the same time as the optical survey before ACD integration.

REASON: This allows the two surveys to be directly compared. The current plan shows that the LAT will be tipped for X-LAT plate integration before the first muon survey. This tipping will probably cause internal alignment shift making survey comparisons difficult.

RESPONSE: Such a test is in our current survey plan as test 1c in LAT-MD-00895 “LAT Instrument Survey Plan”.

### **15. I&T: M. Menning**

REQUEST: Suggest that all non flight hardware/software be the responsibility of I&T and that all technicians and support personnel for I&T activities be hired by I&T. Responsibility includes holding budget and personnel as well as cost and schedule performance.

REASON: Integration and test needs to have increased authority over their schedule performance and hardware/software required for I&T. Org chart shows that mechanical techs but not electronic techs are within I&T organization. Miscellaneous non flight hardware seems to be the responsibility of other organizations.

RESPONSE: The LAT IPO has decided that the current organization will work. To mitigate against misunderstandings between Electronics and I&T concerning allocation of manpower, I&T will produce a detailed Integration and Test Staffing plan well before the IRR. This plan will include the day-to-day labor hours expected from the integrators under the budgetary control of the Electronics Subsystem.

## **16. I&T: M. Menning**

REQUEST: Provide accurate assessment of scheduled late deliveries to I&T by identifying a high density of discrete milestones and earned value for each milestone for each task. If this effort still shows little or no positive float, develop and implement recovery plans for each task which appears late. Provide progress report until schedule is recovered.

REASON: Cal Module A&B shows 0 days float on delivery to I&T (about 5). Chart 6-15 show many projected late deliveries.

RESPONSE: I&T expects deliveries to the level 3 milestones held by the Project Manager.

## **17. I&T: M. Menning**

REQUEST: Evaluate the schedule impact caused by delaying grid turnover to allow epoxy on calplate/grid fasteners to set up /partially cure. (See Mark Molini for curing details).

REASON: A two part epoxy will likely be implemented on several fasteners which attach each cal plate to the grid.

RESPONSE: I&T does not anticipate the additional few hours of cure time specified by Mechanical Systems to impact the integration schedule.

## **18. I&T: T. Kamae**

REQUEST: There should be a scheme to calibrate the absolute efficiency of L1T of the entire LAT. One easy way of doing this is to have a muon telescope exterior to LAT and compare its counting rate with that of LAT. Please show the plan.

REASON: There will be no way to calibrate the absolute trigger efficiency once in orbit.

RESPONSE: There is a way to calibrate the L1T trigger in space using the CAL Low trigger. This is part of the trigger strategy for the LAT. Reference: Project Scientist. We will also be able to use this technique for the ground tests.

## **19. I&T: T. Kamae**

REQUEST: Risk of not doing the Beam Test needs to be estimated in SAS and FSW area.

REASON: Once in orbit, it will be very difficult to calibrate FSW (filtering, etc.) and SAS.

RESPONSE: With the current schedule for the beam test the FSW delivered for the test will not have filtering. This is due to the ELX hardware and FSW schedule that do not support the full flight system for the beam test (e.g., no EPU's). However, the filtering efficiency can be checked offline as part of the verifying the Monte Carlo. A later beam test would not impact complete checks. NB: The FSW would be ready by then. We intend to do a beam test well before launch.

## **20. I&T: D. Horn/B. Marcellini**

REQUEST: Provide sufficient detail with respect to on-orbit calibration to ensure feasibility of on-orbit calibration methods are understood sufficiently to verify that LAT on orbit science performance will be achieved.

REASON: CDR needs to show LAT design achieves science performance requirements, since this depends upon on-orbit calibration.

RESPONSE: The work has been done (TBR), but we only presented a short overview in our presentation. We will show more in the CDR. See the LAT SVAC Plan, LAT-MD-00446, Section 7.

## **21. I&T: E. Shippey**

REQUEST: Need to better describe "loads" during tilt/turnover operations. Is there a point of instability at top of turnover? What are lateral constraints on fixture to prevent movement/slipping?

REASON: When crane/lift point are in line, configuration is very unstable.

RESPONSE: The tilt over stand concept has been replaced with a roll over stand which has continuous control of the LAT during movement. No crane operations are required for rotation. This design has been under development since the Engineering meeting on 3/11/03 during which we discussed LAT assembly.