GLAST Large Area Telescope: I & T Input to Face to Face Managers Meeting,
September 3, 2003

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SU-SLAC
Subsystem Engineer

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LAT Working Schedule (L.K. - 08/13/03)

- **TKR A/B**: 4/15/04 | 7/14/04
- **CAL A/B**: 5/20/04 | 7/14/04
- **TEM A/B**: 5/20/04 | 7/14/04
- **GRID Assembly**: 5/20/04 | 7/14/04
- **TKR 13/14**: 10/21/04 | 12/1/04
- **CAL 13/14**: 10/21/04 | 12/1/04
- **TEM 13/14**: 10/21/04 | 12/1/04
- **ACD**: 9/21/04 | 12/15/04
- **DAQ**: 9/10/04 | 12/15/04
- **X-LAT**: 8/2/04 | 12/15/04
- **Install Tower A/B 8 wk**: 5/20/04 | 7/14/04
- **Install Towers 1-12 12 wk**: 10/28/04 | 12/1/04
- **Install Towers 13/14 2 wk**: 12/15/04
- **Install Global Items 6 wk**: 1/27/05 | 4/7/05
- **4 wk FLOAT**: 11/3/05 | 12/1/05
- **Ship LAT 1 wk**: 7/14/05
- **Environmental Testing 15 wk**: 7/14/05
- **4 wk FLOAT**: 11/3/05 | 12/1/05
- **Pre-ship Review**: 7/14/05
- **CD-4 Review**: Fabrication
- **Commissioning**: 1/27/05 | 4/7/05
- **System Test 14 wk**: 5/5/06 | 7/14/06
- **10 wk FLOAT**: 5/5/06 | 7/14/06
- **Pre-test Review**: 7/14/05
- **Environmental Testing 15 wk**: 7/14/05
- **4 wk FLOAT**: 11/3/05 | 12/1/05
- **Pre-ship Review**: 7/14/05
- **LAT RFI 12/1/05**
<table>
<thead>
<tr>
<th>Milestone ID</th>
<th>Milestone Description</th>
<th>Original Date</th>
<th>Current Date</th>
<th>Major Requirements to Achieve Milestone</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Decision on location of LAT Environmental Test</td>
<td>08/21/03</td>
<td>09/10/03</td>
<td>Spectrum RFI quote. PSR 8/18 checklist.</td>
<td>Required for planning the Environmental Test. Potential locations are NRL and Spectrum Astro.</td>
</tr>
<tr>
<td>9119500160</td>
<td>Receive Tracker mini-tower</td>
<td>08/22/03</td>
<td>08/20/03 Complete</td>
<td></td>
<td>Hand carried from Italy on 8/20/03</td>
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<tr>
<td>91006820</td>
<td>EM tower functional tests complete</td>
<td>09/18/03</td>
<td>09/16/03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>91006822</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>91006930</td>
<td>EM tower available for use by Flight Software</td>
<td>09/18/03</td>
<td>09/19/03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>91006932</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EM Calibration Complete</td>
<td>10/13/03</td>
<td>10/14/03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9119500180</td>
<td>Cal EM at NRL Loading dock</td>
<td>10/17/03</td>
<td>10/17/03</td>
<td>Need to ship by 10/15/03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I&amp;T PMCS rebaseline</td>
<td></td>
<td>10/03/02</td>
<td>Need new baseline subsystem delivery dates for final I&amp;T schedule.</td>
<td>Begin replanning assuming hardware availability dates per Rebaseline Review presented 7/31/03</td>
</tr>
<tr>
<td></td>
<td>Bldg 33 Upgrades (except for humidity)</td>
<td>09/01/03</td>
<td>10/30/03</td>
<td>Earthquake new cabinets, more furniture, all phones in, permanent Liquid Nitrogen system operational, Clinton flight hardware stores complete (fire and earthquake).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bldg 33 A/C &amp; humidity control improvements, plus</td>
<td>12/15/03</td>
<td>12/15/03</td>
<td>Crane fine control adjustment.</td>
<td>A/C + humidity Kingston Chan responsible engineer.</td>
</tr>
<tr>
<td></td>
<td>I&amp;T training mockup complete and ready for use</td>
<td>1/30/03</td>
<td></td>
<td>All I&amp;T mechanical and electrical techs on board and ready to train.</td>
<td>Plan to use (TBR) injected molded plastic parts to the cad model in the 1x4 grid augmented by 4x4 footprint hardware. Also using ELX software test bed.</td>
</tr>
</tbody>
</table>

**4.1.9 - Integration and Test**
# Key Milestone List to delivery

<table>
<thead>
<tr>
<th>Milestone ID</th>
<th>Milestone Description</th>
<th>Original Date</th>
<th>Current Date</th>
<th>Major Requirements to Achieve Milestone</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACD tent work</td>
<td>1/30/04</td>
<td>1/30/04</td>
<td>Investigate using previously used BaBar enclosure.</td>
<td>Needed for ACD  9/1/04</td>
<td></td>
</tr>
<tr>
<td>Single Tower EGSE Configuration including CAL and TKR Production Scripts</td>
<td>9/30/03</td>
<td></td>
<td>Final LATTE scripts for TKR and CAL production. Support for CAL GSI beam test.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multi-FREE Board EGSE.</td>
<td>1/30/03</td>
<td></td>
<td>GASU delivered with software to I&amp;T 12/30/03. Complete LATTE multi FREE Board support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAT Assembly Configuration</td>
<td>4/20/04</td>
<td></td>
<td>Complete LATTE multi tower and FREE Board support. PDU support. Command and Telemetry database. Presented at IRR.</td>
<td>Use this EGSE for initial multi tower debugging and assembly of all towers into Grid.</td>
<td></td>
</tr>
<tr>
<td>Complete Flight Unit Configuration EGSE.</td>
<td>12/15/04</td>
<td></td>
<td>Delivery of Global items, final spacecraft simulator.</td>
<td>Use this EGSE to assemble and test global items, and I&amp;T, comprehensive, limited performance and, end to end LAT tests.</td>
<td></td>
</tr>
<tr>
<td>Flight Unit On-Orbit Configuration EGSE.</td>
<td>12/01/05</td>
<td></td>
<td>All global items installed and tested, final Command and Telemetry database, instrument fully tested, instrument delivered.</td>
<td>Used for SC integration, IOC end to end tests, and flight.</td>
<td></td>
</tr>
<tr>
<td>LAT I&amp;T Beam Test EGSE.</td>
<td>&gt; 12/01/05</td>
<td></td>
<td></td>
<td>Use in SLAC CU beam test.</td>
<td></td>
</tr>
<tr>
<td>MGSE for LAT integration</td>
<td>4/20/04</td>
<td></td>
<td>Qualification and proof tests complete for manufactured items. Presented at IRR.</td>
<td>Excludes the special MGSE for environmental testing.</td>
<td></td>
</tr>
<tr>
<td>MGSE for LAT environmental testing</td>
<td>7/14/05</td>
<td></td>
<td>Qualification and proof tests complete for manufactured items. Presented at pretest/ship review.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arrange for airplane for transportation to NRL/airplane test</td>
<td>7/1/04</td>
<td></td>
<td>Requirements for MGSE and EGSE on airplane known. LAT parts tested as required by the time of delivery of A/B 4/15/04 (TKR), 5/20/04 (CAL/TEM/TPS), …</td>
<td>Past experience with Air Force indicates about one year lead time.</td>
<td></td>
</tr>
</tbody>
</table>

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## 4.1.9 - Integration and Test
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**Single Tower EGSE Configuration including CAL and TKR Production**

**Scripts (9/30/03)**

- **AEM/TEM**
  - External Trigger
  - Electronics/Online
  - Used as is in GSI CAL test.

- **VME Chassis**
  - LAT-COMM
    - External Trigger
  - Main Dataflow Ethernet

- **CPU**
  - Commanding
  - Telemetry
  - Monitoring
  - Hardware Drivers

- **Back door debug RS-232**
- **Online Workstation**
  - Test Exec
  - Configuration
  - Commanding
  - Telemetry
  - Event Processing
  - Monitoring
  - Visualization
  - Data base
  - Message logger
  - Alerts
  - Electronic log

- **Central Database**

- **Subsystems/simulator**
  - Subsystem (or simulator)

- **DC Power**
- **External Hardware**

- **WAN**
Multi-FREE Board EGSE (to ACD Jan 04)

ACD or Sensor Simulator

AEM

GEM

TEMs

CAL, TKR or Sensor Simulator

T&DF System (LAT)

GASU

EBM

EGSE Crate

CPU

LCB

VME

28 V Supply

Online Workstation

EGSE

WAN

Central Database

SLAC

Firewall
GLAST LAT Project

LAT Assembly Configuration (5/20/04)

4.1.9 - Integration and Test
Complete Flight Unit Configuration (12/15/04)

- ACD
- GASU
  - AEM
  - GEM
  - TEMs
- CAL, TKR
- LAT
- EGSE
  - 3 EPUs
    - CPU
    - LCB
  - EGSE Crate
    - CPU
    - LCB
- SIU
  - CPU
  - 1553
  - LCB
- Spacecraft simulator
  - DisCRETES
  - 1553
  - 28 V Supply
  - SSR
- Online Workstation
- SLAC
- WAN
- Central Database
- Firewall

Test Point on LAT EMI Skirt
Flight Unit On-Orbit Configuration (12/01/05)

- GASU:
  - AEM
  - GEM
  - TEMs

- EBM

- SIU:
  - CPU
  - 1553
  - LCB

- 3 EPUs:
  - CPU
  - LCB

- Spacecraft:
  - Discretes
    - 1553
    - 28 V Supply
    - SSR

- WAN:

- Central Database

- Firewall

- IOC Workstation

- SLAC

- LAT:
  - CAL and TKR

- MOC

- Test Point on LAT EMI Skirt
  (Flight cover installed - Green Tag item)
Interdependencies

• I&T has interdependencies with all other subsystems.
  – Handle via ATDP for deliverables
  – Full involvement and signoff with LAT subsystem ICDs
  – Signoff on Systems Engineering LAT Test Plans
  – LAT Managers Face-to-Face meetings
  – LAT Engineering meetings

• Interdependencies with Instrument office
  – LAT Managers Face-to-Face meetings
  – Monthly Review
  – No formal signoff channel after Integrated Project Office dissolved

• Project office
  – Monthly Review
  – Mission SWG
Open Flight Design Issues/Status Trades

- I&T Test Plan
- EGSE plan
  - Acceptance and validation, LAT-MD-01533 draft
  - Release drawings (just cartoons)
  - Cables designed and manufactured
- MGSE plan
  - Development plan needs to be completed, LAT-MD-01462 draft
- Test Requirements
  - LAT comprehensive and limited performance tests
  - LAT end-to-end tests
  - LAT environmental test plan
- Test procedures
  - LAT level test scripts
- Assembly Procedures
- Transportation Plan
• EGSE EM-1 qualification in progress in EM program. EM-1 used for production of flight TKR and CAL units. Final multi tower EGSE qualification needs to use software test bed. Qualification required for use by ACD in Dec/Jan. For more details of the EGSE qualification plan see, MD-01-533 draft.

• MGSE qualification plan discussed in I&T MGSE Development Plan, MD-01-262 draft.
• See LAT working schedule and milestones.
<table>
<thead>
<tr>
<th>Doc #</th>
<th>Document Title</th>
<th>Outline</th>
<th>Draft</th>
<th>Review</th>
<th>QC Written</th>
<th>Release</th>
<th>Comment</th>
<th>Author</th>
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</thead>
<tbody>
<tr>
<td>LAT-MD-01376</td>
<td>LAT Integration &amp; Test Plan</td>
<td>●</td>
<td>○</td>
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<td>Need EM experience, system level test plans finalized, location of environmental test finalized, SE input on comprehensive and end-to-end LAT tests.</td>
<td>Bloom/Grist</td>
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<td>LAT-MD-01137</td>
<td>LAT EM Test Plan</td>
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<td>Bloom</td>
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<td>LAT-MD-01533</td>
<td>EGSE Plan</td>
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<td>Needs Revision</td>
<td>Bloom/Claus</td>
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<td>LAT-MD-00446</td>
<td>SVAC Plan</td>
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<td>do Couto E Silva</td>
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<td>LAT-MD-01587</td>
<td>SVAC Test Plan</td>
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<td>Released</td>
<td>do Couto E Silva</td>
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<td>LAT-MD-01598</td>
<td>LAT Weight and CG Test Plan</td>
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<td>Released</td>
<td>Gawehn</td>
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<td>LAT-MD-01462</td>
<td>MGSE Development Plan</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>Needs Revision</td>
<td>Gawehn</td>
</tr>
<tr>
<td>LAT-MD-01836</td>
<td>LAT Dynamics Test Performance Plan</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>Needs dynamics test plan released from SE.</td>
<td>Lovellette/Gawehn</td>
</tr>
<tr>
<td>LAT-MD-01837</td>
<td>LAT Thermal Test Performance Plan</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>Needs thermal test plan released from SE.</td>
<td>Lovellette/Gawehn</td>
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<tr>
<td>LAT-MD-01838</td>
<td>LAT EMI/EMC Test Performance Plan</td>
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<td>●</td>
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<td>●</td>
<td>Needs EMI/EMC test plan released from SE.</td>
<td>Lovellette/Gawehn</td>
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<tr>
<td>LAT-MD-00676</td>
<td>LAT Assembly Sequence</td>
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<td>●</td>
<td>●</td>
<td>○</td>
<td>Needs Revision, EM experience important input</td>
<td>Wai</td>
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<tr>
<td>LAT-MD-01386</td>
<td>LAT Facilities Plan</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>Released, but comments for rev 2 have been received from Darren.</td>
<td>Wai</td>
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<tr>
<td>LAT-MD-01586</td>
<td>LAT Survey &amp; Alignment Performance Plan</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>Needs Revision and input from Martin Nordby. Interacts with LAT survey plan and pointing requirement.</td>
<td>Wai</td>
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<tr>
<td>LAT-MD-01055</td>
<td>LAT Electrical Test Performance plan</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>Released, but needs revision from EM experience.</td>
<td>Wai</td>
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<tr>
<td>LAT-MD-00440</td>
<td>LAT Particle Test Plan</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>In signoff</td>
<td>Godfrey</td>
</tr>
</tbody>
</table>
Issue/concerns/suggestions/risks

- Time frame and effort needed for rebaselining.
- Need for electronics technician to be under I&T control – currently under electronics and not shown in PMCS. Under projected schedule I&T needs to start hiring to prepare for flight integration before the end of this year. Currently no qualified electronics tech allocated to I&T.
- Impact of CAL plate interface design on flight integration procedures. E.g., will we need to check for voids in epoxy when installing Menning plates. Close coordination with I&T requested.
- Finalization of all LAT test plan requirements is not complete. This is resulting in compressed schedule and likely increased cost for I&T. Current estimates are 03/01/04 for completing all test plans.
- Spacecraft interface detail uncertainty.
  - Environmental test fixtures.
  - EGSE interface.
  - MGSE handling fixtures.
  - SIIS (Spacecraft Instrument Interface Simulator) fidelity uncertainty. Signoff will be 09/10/03.
- Delivery of flight hardware to I&T may be late.
Connector Savers

- **Examples of connector savers from LAT-MD-00676-01**
  - 9.2.3.7. Remove TKR flex cable **connector-saver** and connect to respective TEM box connector.
  - 9.3.1.2. Connect TEM and TPS to Single Bay Electrical Test Equipment using test cable harness. Temporarily tape test cables the top of each TPS box (TBD) to ensure TEM connectors aren't over stressed during test activity. Note, test cable harness is integrated to TEM and TPS with **connector savers** on the boxes
**Glaxt Lat Project**  
**Face to Face Meeting 090303**

**Bays 8+9 Installation/TEM-Level and System Level Test**

**Installation/TEM-Level**

1. **Step 1**: Install Bay 9 TKR, CAL+TEM/PSU. TEM connector savers already on at delivery. Install TEM-level test cables and perform Bay 9 TEM-level test.

2. **Step 2**: Remove Bay 9 connector savers, remove TEM-level test cables. Install Bay 8 TKR, CAL+TEM/PSU. Bay 8 TEM connectors savers already on at delivery. Install TEM-level test cables and perform Bay 8 TEM-level test.


**System Level Test**

1. **Pair 1**

2. **Pair 2**

3. **Pair 3**

**4.1.9 - Integration and Test**

- **Step 1**: Complete installation of Bays 8, 9, intervening cable tray, and TEM flight cables.
- **Step 2**: Temporarily fasten EM PDU+ EM GASU+power/test cables and perform Bays 8,9 Multi-Tower test.
- **Step 3**: Remove EM PDU, EM GASU, power/test cables.
Bay Installation/Test Sequence

Step 1: Complete installation and test of Pair 1 (Bays 8, 9, intervening cable tray, and TEM flight cables)

Step 2: Complete installation and test of Pair 2. EM PDU now remains in place until installation of flight PDU

Step 3: Complete installation and test of Pair 3

Step 4: Complete installation and test of Pair 4. EM GASU now remains in place until installation of flight GASU

Step 5: Complete installation and test of Pair 5

Step 6: Installation/test of Pair 6, install +/- X cable trays, fasten flight cables. System level test.

Step 7: Complete installation and test of Pair 7

Step 8: Installation/test of Pair 7, install +/-X cable trays, fasten flight cables. System level test.

Step 9: Installation/test of Pair 8, install +/-X cable trays, fasten flight cables. System level test.
4.1.9 - Integration and Test

Step 1: Remove EM GASU, install test instrumentation on grid, install flight GASU, remove connector savers and perform flight mates. System level test.

Step 2: Remove EM PDU, install flight PDU, PDU-GASU cable, and perform flight mates. System level test.

Step 3: Install EPU, EPU-PDU cable, and EPU-GASU cable. System level test. Repeat for all 3 units.

Step 4: Install SIU, SIU-PDU cable, SIU-GASU cable. System level test. Repeat for both units.

Step 5: Install EMI skirt, Bulkhead feed through panels/cables. System level test. ACD FREE simulator test.

All TEM-PSU positions w/o an Electronic Module have EMPTY Boxes mounted to them.