GLAST Large Area Telescope:

LAT System Engineering

Dick Horn
SLAC
System Engineering Manager

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408 771-3550
Topics

• Action Item Status
• Technical Baseline Management
• Requirements Management
• Verification Planning
• Interface Control Documentation
• RFA Closure
• Key Metrics
• Risk Management
## Monthly Action Item Status

<table>
<thead>
<tr>
<th>Action Item ID</th>
<th>Actionee</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-30-03-006</td>
<td>Haller</td>
<td>For TEM/TEM PS to be provided to CAL Qual/Accept program; provides a specific list of differences from flight (hardware/software/performance), include any constraints for use (T/V, EMC.....)</td>
<td><strong>OPEN</strong>: ECD 27 August; ECD 29 October Provided email to N. Thompson on 10/27</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-30-03-007</td>
<td>Haller</td>
<td>Provide current software schedule to Project Office, include specific time frame where integrated EM1 S/W in integrated configuration (all modules w/ planned capability)</td>
<td><strong>Closed</strong>: Updated schedule provided 11 September. Further development required for rebaseline. ECD 29 October</td>
</tr>
<tr>
<td></td>
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<tr>
<td>7-30-03-008</td>
<td>Jerry Clinton</td>
<td>Define and maintain the production readiness/execution plan to include vendor selection and associated schedule to ensure unit availability dates are met</td>
<td><strong>OPEN</strong>: Draft production plan completed &amp; provided to GSFC. Refinement required as vendors are selected. ECD: 17 December</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>7-30-03-009</td>
<td>Dick Horn</td>
<td>Establish subsystem metrics to ensure critical design elements are closing (e.g. drawings) and fabrication issues are monitored for closure and adverse trends (e.g. NCRs), phase in as possible</td>
<td><strong>OPEN</strong>: Initial drawings and process status in place. Power &amp; mass updates included in this package. Planning for NCR tracking in work ECD: 15 December.</td>
</tr>
</tbody>
</table>
Technical Baseline

Progress

– Transitioned to LATDocs
  • Still a few issues in the reports and document status
  • Broke semi-automated drawing status process
– Briefed the team during the weekly Engineering Meeting on 9/30 and the Face-to-Face in October
– Created Engineering Issues List, had first pass presentation at the weekly Engineering meeting on 10/21
– Held working meeting on Solid Edge model management
  • Will result in additional intermediate placeholder drawings to connect subsystem models with Lat level models
– DAQ created TEM drawing package as a pathfinder, feedback from this package should speed the review process on later packages

Plans

– Complete capture of technical baseline
  • Finalize drawing tree (including intermediate levels) by end of November (ensures all drawings are captured)
  • Review subsystem milestones for possible high level schedule of drawings vs time
## Drawing Metrics

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Total</th>
<th>Planned</th>
<th>In Progress</th>
<th>Complete</th>
</tr>
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<tbody>
<tr>
<td>Anticoincidence</td>
<td>100</td>
<td>20</td>
<td>16</td>
<td>64</td>
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<tr>
<td>Detector</td>
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<tr>
<td>Tracker</td>
<td>92</td>
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<td>37</td>
<td>55</td>
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<tr>
<td>Calorimeter</td>
<td>141</td>
<td>11</td>
<td>18</td>
<td>112</td>
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<tr>
<td>Mechanical</td>
<td>56</td>
<td>11</td>
<td>40</td>
<td>11</td>
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<tr>
<td>Data Acquisition</td>
<td>185</td>
<td>80</td>
<td>105</td>
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<tr>
<td>Integration</td>
<td>6</td>
<td>6</td>
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<tr>
<td>Instrument Total</td>
<td>580</td>
<td>112</td>
<td>216</td>
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<tr>
<td></td>
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<td>21%</td>
<td>37%</td>
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<tr>
<td>No.</td>
<td>Title/Description</td>
<td>Description/Status</td>
<td>Need Date</td>
<td>Actionee</td>
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<tr>
<td>-----</td>
<td>-------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>1</td>
<td>Cal grid interface design not complete</td>
<td>Peer review held. Recommended mod to pad size approved through CRB. Bolt pattern change to be ICN to the Spectrum ICD.</td>
<td>Closed</td>
<td>M. Nordby</td>
</tr>
<tr>
<td>2</td>
<td>X-lat to electronics thermal interface not complete</td>
<td>Design nearly complete, still a few issues to work out. Peer review expected by end of October (Nov 5)</td>
<td></td>
<td>N. Nordby</td>
</tr>
<tr>
<td>3</td>
<td>Technical baseline</td>
<td>Drawing Tree completion by end of Oct. All drawings under CM prior to flight build. 1 Jan need date under review</td>
<td>1 Jan 04</td>
<td>P. Hascall</td>
</tr>
<tr>
<td>4</td>
<td>Tracker/tem/temps flex cable layouts</td>
<td>Conceptual redesign is complete, need to update drawings. Peer review 28 Oct</td>
<td>ASAP</td>
<td>M. Nordby</td>
</tr>
<tr>
<td>5</td>
<td>EMI/EMC design</td>
<td>Following items will be implemented to mitigate EMI/EMC issues: E Ni plating on metal to metal surfaces, Cal to implement presented design mods EMI gaskets per discussions with Fred, Venting unchanged</td>
<td>ASAP</td>
<td>F. Blanchette</td>
</tr>
<tr>
<td>No.</td>
<td>Title/Description</td>
<td>Description/Status</td>
<td>Need Date</td>
<td>Actionee</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>-------------</td>
<td>-----------</td>
</tr>
<tr>
<td>6</td>
<td>CAL dual PIN photodiode wire bonds suspect</td>
<td>Have remedial action for two suspected causes (tinning and thermal shock).</td>
<td>Closed</td>
<td>W. Johnson</td>
</tr>
<tr>
<td>7</td>
<td>Qualification of plastic encapsulated ASICs</td>
<td>Document to support qualification determined, DAQ has agreed to dates.</td>
<td>Closed</td>
<td>G. Haller</td>
</tr>
<tr>
<td>8</td>
<td>GTRC TOT timeouts</td>
<td>Cause understood. Fix would require GTRC redesign or correct in TEM.</td>
<td>ASAP</td>
<td>R. Johnson</td>
</tr>
<tr>
<td>9</td>
<td>GTRC extra clock delay</td>
<td>Fix to GTRC to correct understood. Fixing clock rise time is not enough.</td>
<td>ASAP</td>
<td>R. Johnson</td>
</tr>
<tr>
<td>10</td>
<td>Tracker EM program completion</td>
<td>Planned vib test in mid Nov and TV test starting early December using thermal model.</td>
<td>19 Dec 03</td>
<td>R. Johnson</td>
</tr>
<tr>
<td>No.</td>
<td>Title/Description</td>
<td>Description/Status</td>
<td>Need Date</td>
<td>Actionee</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>-----------</td>
<td>----------</td>
</tr>
<tr>
<td>11</td>
<td>ACD TDA flexure / fiber interference</td>
<td>Rerouted fibers, tapered flexures and moved some flexures. Performing final analysis, drawings in review. Present in Engineering review in November</td>
<td>Nov</td>
<td>D. Thompson</td>
</tr>
<tr>
<td>12</td>
<td>ACD – LAT interface definition not complete</td>
<td>Cable tie downs to be addressed by the LAT. Remainder in work at low priority. (Will be broken into several issues as Martin plans effort)</td>
<td></td>
<td>M. Nordby</td>
</tr>
<tr>
<td>13</td>
<td>Tracker MCM attachment and wire bonding</td>
<td>Test boards from preproduction group to be sent to Italy for inspection to verify solution</td>
<td>1 Dec 03</td>
<td>R. Johnson</td>
</tr>
<tr>
<td>14</td>
<td>X-LAT heat pipe must be internally SPF tolerant</td>
<td>Decision made to add U shaped heat pipes. Peer per AI 2 on 5 Nov.</td>
<td>31 Oct 03 Closed</td>
<td>M. Nordby</td>
</tr>
</tbody>
</table>
### Issues (Continued)

<table>
<thead>
<tr>
<th>No.</th>
<th>Title/Description</th>
<th>Description/Status</th>
<th>Need Date</th>
<th>Actionee</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Radiator integration clearances not sufficient</td>
<td>Resolution will impact either Grid wing cutouts or Radiator cut outs.</td>
<td>13 Nov</td>
<td>M. Nordby</td>
</tr>
<tr>
<td>16</td>
<td>Fly away instrumentation not finalized</td>
<td>Locations must be finalized to be able to assess impacts to Tracker Grid and DAQ. Radiator thermistors are the first priority due to DAQ schedule. Internal accels and strain gauge counts and locations to be updated by 31 October.</td>
<td>ASAP for thermistors</td>
<td>Hascall</td>
</tr>
<tr>
<td>17</td>
<td>New coupled loads results may create negative margins</td>
<td>Analysis nearly complete. Results positive – critical loads went down.</td>
<td>30 Oct</td>
<td>J. Ku</td>
</tr>
<tr>
<td>18</td>
<td>EMI/EMC requirements and test</td>
<td>System analysis tool under development, requires subsystems help. Will result in test requirements documented in the Performance Verification Plan</td>
<td></td>
<td>F. Blanchette</td>
</tr>
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</table>
## GLAST LAT Materials & Parts List

<table>
<thead>
<tr>
<th>Total List</th>
<th>Inorganic</th>
<th>Polymer &amp; Composite</th>
<th>Lubricant</th>
<th>Process</th>
<th>Total</th>
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<td>ACD</td>
<td>36</td>
<td>47</td>
<td>1</td>
<td>13</td>
<td>97</td>
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<td>Calorimeter</td>
<td>21</td>
<td>32</td>
<td>2</td>
<td>7</td>
<td>62</td>
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<tr>
<td>Electronics</td>
<td>6</td>
<td>12</td>
<td>2</td>
<td>4</td>
<td>24</td>
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<tr>
<td>Mechanical</td>
<td>117</td>
<td>26</td>
<td>4</td>
<td>13</td>
<td>160</td>
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<td>I&amp;T</td>
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<td>Tracker</td>
<td>24</td>
<td>37</td>
<td>2</td>
<td>3</td>
<td>66</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>204</strong></td>
<td><strong>154</strong></td>
<td><strong>11</strong></td>
<td><strong>40</strong></td>
<td><strong>409</strong></td>
</tr>
<tr>
<td>Accepted by LAT</td>
<td>202</td>
<td>150</td>
<td>11</td>
<td>39</td>
<td>402</td>
</tr>
<tr>
<td>Approved by GSFC</td>
<td>202</td>
<td>150</td>
<td>11</td>
<td>39</td>
<td>402</td>
</tr>
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</table>
Requirements Traceability & Verification Planning
Requirements Traceability and Verification

- Continuous tracking of requirements changes (Monthly Status)
  - Level 2 and 3 documents undergoing revision
    - IOC Level 2 Specification, LAT-SS-00015
    - LOF Level 3 Specification, LAT-SS-00021
  - Changed Level 2 and 3 documents to be incorporated
    - ACD Level 3 Specification, LAT-SS-00016, released 9/30
- Continuous maintenance of verification matrix
Test Data Requirements

- Internal review of LAT Test plan and present mechanical test plan

Test Planning

- Continued revision of LAT Test Plan
  - Topic of 11/04 Eng Meeting
- Reviewed Radiator flow to include Radiators installed for EMI testing

Test Performance

- Modified LAT Test plan to include Radiators in LAT EMI Tests
- Updated LAT re-plan to I&T schedule and added required Test support activities
- Meeting with I&T to resolve the work to be performed
Interface Management
# LAT-SC Interface – Open Issues

<table>
<thead>
<tr>
<th>System</th>
<th>Subject</th>
<th>Closure Path</th>
<th>Need Date</th>
<th>Promise Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>Digital signal grounding</td>
<td>Spectrum performing observatory</td>
<td>6/1/2004</td>
<td>6/1/2004</td>
<td>Digital ground pins currently exist on LAT and Spectrum ebox connectors. Decision to add ground wires to flight harness needs to be made before harness build scheduled to begin in summer '04.</td>
</tr>
<tr>
<td>Mech</td>
<td>LAT Flexure Interface Details</td>
<td>Spectrum preparing ICN.</td>
<td>10/15/2003</td>
<td>Done</td>
<td>Reviewing preliminary I/F information now, formal review after CCR received. GSFC CCB 10/16. Spectrum is preparing ICD change.</td>
</tr>
<tr>
<td>Mech</td>
<td>LAT Radiator I/F pad size</td>
<td>GSFC preparing CCR.</td>
<td>10/15/2003</td>
<td>Done</td>
<td>Is in 00040 (LAT document). Need a CCR to put this into the IRD.</td>
</tr>
<tr>
<td>Mech</td>
<td>LAT Connector Locations</td>
<td>LAT Provide</td>
<td>10/15/2003</td>
<td>11/30/2003</td>
<td>Need X, Y and Z locations with connector orientations</td>
</tr>
<tr>
<td>Mech</td>
<td>Harness Routing on LAT</td>
<td>LAT Provide</td>
<td>10/15/2003</td>
<td>11/30/2003</td>
<td>Need pictures for ICD</td>
</tr>
<tr>
<td>Mech</td>
<td>Harness Support on LAT</td>
<td>LAT Provide</td>
<td>10/15/2003</td>
<td>11/30/2003</td>
<td>Need definition of support hardware</td>
</tr>
<tr>
<td>Therm</td>
<td>LAT Thermal Model Size</td>
<td>GPO Agree on Model, update IRD</td>
<td>10/15/2003</td>
<td>Done</td>
<td>Update IRD to clean up compliance. Delivery to GSFC finished. Still checking model at GSFC.</td>
</tr>
<tr>
<td>Therm</td>
<td>Heat transfer from SC to LAT Radiator Backsurface</td>
<td>LAT Provide</td>
<td>10/15/2003</td>
<td>Done</td>
<td>SC proposed &lt;2W. LAT prepared ICN-34 and forwarded to Spectrum.</td>
</tr>
<tr>
<td>Elec</td>
<td>LAT current transients</td>
<td>Spectrum Provide</td>
<td>10/15/2003</td>
<td>Waiting</td>
<td>Waiting for measurements from Spectrum. Plan to sign up to measured values and close then.</td>
</tr>
<tr>
<td>Elec</td>
<td>LAT Impedence</td>
<td>Spectrum Provide</td>
<td>10/15/2003</td>
<td>Waiting</td>
<td>Waiting for measurements from Spectrum. Plan to sign up to measured values and close then.</td>
</tr>
<tr>
<td>Elec</td>
<td>42 V Input Voltage</td>
<td>GSFC to Respond</td>
<td>ASAP</td>
<td>Waiting</td>
<td>LAT submitted request to change IRD. Awaiting GSFC response.</td>
</tr>
<tr>
<td>Elec</td>
<td>LAT startup plan (?)</td>
<td>LAT Provide</td>
<td>10/15/2003</td>
<td>Waiting</td>
<td>Bernie has an action to define this. Was this in ICD lien list? Will provide a baseline for CDR.</td>
</tr>
</tbody>
</table>
ICN’s

• LAT signed this month
  – ICN-8 Clarify <75W LAT Radiator IR Backloading Requirement (10-2-03)
  – ICN-23 LAT Interface Connector Pin-out Definitions (10-2-03)
  – ICN-24 LAT Survival Feed Connector Redefinition (10-10-03)
  – ICN-27 LAT Discrete Control Command Logic & Signal Names (10-10-03)
  – ICN-16R1 LAT-SC System Grounding (10-13-03)
  – ICN-31 Define Length of LAT Science Data Packet (10-13-03)
  – ICN-32 LAT Science Name Consistency (10-13-03)
  – ICN-34 Heat Transfer from SC Non-MLI Surfaces (10-13-03)

• Currently under signature review
  – None

• Currently in draft or revision
  – ICN-9 Reduce the High Speed Science Data Rate
  – ICN-17 LAT Alignment during Test
  – ICN-25 Add SC RT Address to 1553 Protocol Document
  – ICN-33 LAT Analog RTD Part Type
## Interface Documentation Status

<table>
<thead>
<tr>
<th>Document</th>
<th>Status</th>
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<tbody>
<tr>
<td>LAT-SC Interface Control Document (Spectrum Astro Managed Document)</td>
<td></td>
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<tr>
<td>1196 EI-Y46311-000</td>
<td>Released 25 Apr 03</td>
</tr>
<tr>
<td>1553 Bus Potocol Document</td>
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</tr>
<tr>
<td>1196 EI-S46310-000</td>
<td>Released 25 Apr 03</td>
</tr>
<tr>
<td>GBM-LAT Interface Control Document</td>
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<tr>
<td>433-ICD-0001</td>
<td>Second draft in-process</td>
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<tr>
<td>Calorimeter</td>
<td></td>
</tr>
<tr>
<td>LAT-DS-00233-6: CAL-LAT Interface Definition Drawing</td>
<td>Released 6 May 03</td>
</tr>
<tr>
<td>LAT-SS-00238-4: CAL-LAT Mech, Therm, Elec Interface Control Document</td>
<td>Released 13 Mar 03</td>
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<tr>
<td>ACD</td>
<td></td>
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<tr>
<td>LAT-DS-00309-3: ACD-LAT Interface Definition Drawing</td>
<td>Released 22 Apr 03</td>
</tr>
<tr>
<td>LAT-SS-00363-5: ACD-LAT Mech, Therm, Elec Interface Control Document</td>
<td>Released 28 Apr 03</td>
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<tr>
<td>Tracker</td>
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<tr>
<td>LAT-DS-00851-1: TKR-LAT Interface Definition Drawing</td>
<td>Second draft in-process</td>
</tr>
<tr>
<td>LAT-SS-00138-5: TKR-LAT Mech, Therm Interface Control Document</td>
<td>Released 14 Apr 03</td>
</tr>
<tr>
<td>LAT-SS-00176-2: TKR-LAT Elec Interface Control Document</td>
<td>Released 27 Jan 03</td>
</tr>
<tr>
<td>Electronics</td>
<td></td>
</tr>
<tr>
<td>LAT-DS-01630-1: Electronics-LAT Interface Definition Drawing</td>
<td>First draft review complete</td>
</tr>
<tr>
<td>LAT-SS-01794-1: Elec-LAT Mech, Therm, Elec Interface Control Document</td>
<td>Second draft in-process</td>
</tr>
<tr>
<td>SAS</td>
<td></td>
</tr>
<tr>
<td>LAT-SS-02365-1: SAS-LAT Interface Control Document</td>
<td>First draft in-process</td>
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## Working CDRL Delivery List

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<th>NO.</th>
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<th>FROM</th>
<th>TO</th>
<th>MATURITY</th>
<th>Promise Date</th>
<th>STATUS/NOTES</th>
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<tbody>
<tr>
<td>1.</td>
<td>LAT Safety Input to Launch Vehicle Documentation</td>
<td>Meet Range Safety Requirements</td>
<td>LAT</td>
<td>SAI</td>
<td>Preliminary</td>
<td>Feb. '04 Nov. '05</td>
<td>Prelim. MCDR- 2 months</td>
</tr>
<tr>
<td>2.</td>
<td>Spacecraft I &amp; T Support</td>
<td>Obs. Development</td>
<td>LAT</td>
<td>SAI</td>
<td>N/A</td>
<td>Dec. '05</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Launch Vehicle I &amp; T Support</td>
<td>Obs. Testing</td>
<td>LAT</td>
<td>SAI/LV</td>
<td>N/A</td>
<td>Dec. '05</td>
<td>Items 2 &amp; 3 previously combined</td>
</tr>
<tr>
<td>4.</td>
<td>Support Development of S/C I &amp; T Procedures</td>
<td>Obs. Testing</td>
<td>LAT</td>
<td>SAI</td>
<td>N/A</td>
<td>Nov. '05</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>LAT Delivery</td>
<td>Obs. I &amp; T</td>
<td>LAT</td>
<td>SAI</td>
<td>FM</td>
<td>Dec '05</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>LAT GSE (Mechanical and Electrical)</td>
<td>Obs. I &amp; T</td>
<td>LAT</td>
<td>SAI</td>
<td>FM</td>
<td>Dec '05</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Flight Connectors</td>
<td>Obs. I &amp; T</td>
<td>SAI</td>
<td>LAT</td>
<td>Test</td>
<td>Oct '03</td>
<td>LAT Awaiting Delivery</td>
</tr>
<tr>
<td>9.</td>
<td>LAT FEM (Full)</td>
<td>Obs. Strength (10.03)</td>
<td>LAT</td>
<td>SAI</td>
<td>CDR+</td>
<td>Oct. 30 Dec '03 Delivered FEM</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>LAT STEP</td>
<td>ICD Documentation (harness routing, connectors, etc)</td>
<td>LAT</td>
<td>SAI</td>
<td>CDR</td>
<td>Dec '03 Definition required w/SAI</td>
<td></td>
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<tr>
<td>11.</td>
<td>LAT Mass Properties Information</td>
<td>SAI to build mass simulators for S/C structural qualification</td>
<td>LAT</td>
<td>SAI</td>
<td>CDR</td>
<td>Dec '03</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>LAT Radiation Source Survey</td>
<td>Identify sources of radiation for range</td>
<td>LAT</td>
<td>SAI</td>
<td>CDR</td>
<td>Dec '05</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>LAT Instrument/Spacecraft Simulator</td>
<td>Obs. Development</td>
<td>LAT</td>
<td>SAI</td>
<td>FINAL</td>
<td>Apr '04</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Spacecraft/LAT Instrument Simulator</td>
<td>LAT Development DIIS SIIS</td>
<td>SAI</td>
<td>LAT</td>
<td>Preliminary</td>
<td>Jul '03 Dec '03</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>LAT Input to ICD</td>
<td>ICD Development</td>
<td>LAT</td>
<td>SAI</td>
<td>Updates</td>
<td>See attached ICD closure list per priority</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>S/C Flexures (Flight Like)</td>
<td>LAT Testing Model Hardware</td>
<td>SAI</td>
<td>LAT</td>
<td>Test</td>
<td>10/30/03 3/04 Flight Flexures remain at SAI</td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>Drill Template</td>
<td>LAT</td>
<td>SAI</td>
<td>LAT</td>
<td></td>
<td>1/04</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>S/C Acoustic Simulator</td>
<td>LAT Model (FEM) Hardware</td>
<td>SAI</td>
<td>LAT</td>
<td></td>
<td>12/04 4/05</td>
<td></td>
</tr>
</tbody>
</table>
RFA Closure

- Coordinated plan of attack in place – Horn/Graf/Hascall/Melton
  - 37 RFAs total, submitted 17 answers, have 5 draft answers and 5 answers in final review
  - GSFC/LAT consolidation (murder board review) of CDR RFAs held in conjunction with the Face-to-Face meeting at Goddard
  - Plan is to complete 11 by end of October and the final 9 by the end of December
- Current status of all RFA’s on SE website
Key Design Metrics
## LAT Mass Status

**LAT Mass Status Report**

**LAT Mass Status**

Martin Nordby

**Effective Date:** 29-Oct-03  
**Print Date:** 28-Oct-03

### October 2003

<table>
<thead>
<tr>
<th>Mass (kg)</th>
<th>Estimate</th>
<th>Alloc.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>TKR</td>
<td>504.9</td>
<td>510.0</td>
<td></td>
</tr>
<tr>
<td>CAL</td>
<td>1374.3</td>
<td>1440.0</td>
<td></td>
</tr>
<tr>
<td>ACD</td>
<td>278.8</td>
<td>280.0</td>
<td></td>
</tr>
<tr>
<td>Mech</td>
<td>358.6</td>
<td>345.0</td>
<td></td>
</tr>
<tr>
<td>Elec</td>
<td>226.2</td>
<td>220.0</td>
<td></td>
</tr>
<tr>
<td>I&amp;T</td>
<td>7.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td><strong>LAT Total</strong></td>
<td><strong>2749.9</strong></td>
<td><strong>2795.0</strong></td>
<td><strong>100%</strong></td>
</tr>
<tr>
<td>Rsrv/Margin</td>
<td>250.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rsrv/Margin*</td>
<td>9.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Allocation</strong></td>
<td><strong>3000.0</strong></td>
<td><strong>3000.0</strong></td>
<td><strong>3000.0</strong></td>
</tr>
</tbody>
</table>

* AIAA G-020 recommended min reserve = 6.2%

### Center of Mass (mm)

<table>
<thead>
<tr>
<th>Center of Mass</th>
<th>CMx</th>
<th>CMy</th>
<th>CMz</th>
<th>Ht off LIP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.67</td>
<td>-0.94</td>
<td>-71.69</td>
<td>164.51</td>
</tr>
</tbody>
</table>

-20 < CMx < 20  
-20 < CMy < 20  
CMz < -51.2  
Ht < 185

### Second Moment of Inertia (kg-m²)

<table>
<thead>
<tr>
<th>Second Moment</th>
<th>Ixx</th>
<th>Iyy</th>
<th>Izz</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1047.8</td>
<td>1004.0</td>
<td>1386.0</td>
</tr>
</tbody>
</table>

-1500.0  
1500.0  
2000.0

---

**Mass Estimate Breakdown**

<table>
<thead>
<tr>
<th>Mass Estimate Breakdown</th>
<th>(kg)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parametric</td>
<td>229.4</td>
<td>8.3%</td>
</tr>
<tr>
<td>Calculated</td>
<td>1050.5</td>
<td>38.2%</td>
</tr>
<tr>
<td>Measured</td>
<td>1470.0</td>
<td>53.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2749.9</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

---

**LAT System Engineering**  

**GSFC Monthly, 29 Oct 2003**
# LAT Power Status

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimate (Watts)</th>
<th>PARA (Watts)</th>
<th>CALC (Watts)</th>
<th>MEAS (Watts)</th>
<th>ALLOC. (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACD</td>
<td>9.4</td>
<td>2.3</td>
<td>3.9</td>
<td>3.2</td>
<td>10.5</td>
</tr>
<tr>
<td>Tracker</td>
<td>152.4</td>
<td>1.5</td>
<td>0.0</td>
<td>150.9</td>
<td>153.0</td>
</tr>
<tr>
<td>Calorimeter</td>
<td>64.9</td>
<td>0.0</td>
<td>0.0</td>
<td>64.9</td>
<td>65.0</td>
</tr>
<tr>
<td>Trigger &amp; Data Flow</td>
<td>340.9</td>
<td>227.6</td>
<td>86.8</td>
<td>26.6</td>
<td>327.5</td>
</tr>
<tr>
<td>Grid/thermal</td>
<td>20.4</td>
<td>20.4</td>
<td>0.0</td>
<td>0.0</td>
<td>35.0</td>
</tr>
<tr>
<td>Instrument Total</td>
<td>588.0</td>
<td>251.8</td>
<td>90.6</td>
<td>245.6</td>
<td>591.0</td>
</tr>
<tr>
<td>Instrument Allocation</td>
<td>650.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Reserve</td>
<td>10.5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PDR Reserve Was 15.2%**

**CDR Reserve Was 13.4%**

**Goal for PSRR Reserve > 5%**

---

**PARA** - Best Estimate based on conceptual design parameters

**CALC** - Estimate based on Calculated power from detailed design documentation

**MEAS** - Actual power measurements of components

## FSW Resource Usage Current Estimates

<table>
<thead>
<tr>
<th>Resource</th>
<th>Total Available</th>
<th>Anticipated Usage</th>
<th>Margin Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPU Boot PROM</td>
<td>256 kB</td>
<td>128 kB</td>
<td>2</td>
</tr>
<tr>
<td>SIU Boot PROM</td>
<td>256 kB</td>
<td>128 kB</td>
<td>2</td>
</tr>
<tr>
<td>EPU EEPROM</td>
<td>4 MB</td>
<td>1.5 MB</td>
<td>2.7</td>
</tr>
<tr>
<td>SIU EEPROM</td>
<td>8 MB</td>
<td>1.5-2.5 MB</td>
<td>3-5</td>
</tr>
<tr>
<td>EPU CPU cycles</td>
<td>200% in 2 EPUs</td>
<td>30%</td>
<td>&gt; 6</td>
</tr>
<tr>
<td>SIU CPU cycles</td>
<td>100% in 1 SIU</td>
<td>25%</td>
<td>4</td>
</tr>
<tr>
<td>EPU memory</td>
<td>128 MB</td>
<td>16-32 MB</td>
<td>4-8</td>
</tr>
<tr>
<td>SIU memory</td>
<td>128 MB</td>
<td>&lt; 16 MB</td>
<td>8</td>
</tr>
<tr>
<td>Bandwidth – instrument to EPU</td>
<td>20 MB/sec</td>
<td>5 MB/sec</td>
<td>4</td>
</tr>
<tr>
<td>Bandwidth – EPU or SIU to SSR</td>
<td>5 MB/sec</td>
<td>40 kB/sec</td>
<td>112</td>
</tr>
<tr>
<td>Bandwidth – CPU to CPU</td>
<td>2.5 MB/sec</td>
<td>20 kB/sec</td>
<td>125</td>
</tr>
</tbody>
</table>
### Key Science Performance Metrics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SRD Value</th>
<th>Present Design Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Effective Area (in range 1-10 GeV)</td>
<td>&gt;8000 cm²</td>
<td>10,000 cm² at 10 GeV</td>
</tr>
<tr>
<td>Energy Resolution 100 MeV on-axis</td>
<td>&lt;10%</td>
<td>9%</td>
</tr>
<tr>
<td>Energy Resolution 10 GeV on-axis</td>
<td>&lt;10%</td>
<td>8%</td>
</tr>
<tr>
<td>Energy Resolution 10-300 GeV on-axis</td>
<td>&lt;20%</td>
<td>&lt;15%</td>
</tr>
<tr>
<td>Energy Resolution 10-300 GeV off-axis (&gt;60°)</td>
<td>&lt;6%</td>
<td>&lt;4.5%</td>
</tr>
<tr>
<td>PSF 68% 100 MeV on-axis</td>
<td>&lt;3.5°</td>
<td>3.37° (front), 4.64° (total)</td>
</tr>
<tr>
<td>PSF 68% 10 GeV on-axis</td>
<td>&lt;0.15°</td>
<td>0.086° (front), 0.115° (total)</td>
</tr>
<tr>
<td>PSF 95/68 ratio</td>
<td>&lt;3</td>
<td>2.1 front, 2.6 back (100 MeV)</td>
</tr>
<tr>
<td>PSF 55°/normal ratio</td>
<td>&lt;1.7</td>
<td>1.6</td>
</tr>
<tr>
<td>Field of View</td>
<td>&gt;2 sr</td>
<td>2.4 sr</td>
</tr>
<tr>
<td>Background rejection (E&gt;100 MeV)</td>
<td>&lt;10% diffuse</td>
<td>6% diffuse (adjustable)</td>
</tr>
<tr>
<td>Point Source Sensitivity(&gt;100MeV)</td>
<td>&lt;6×10⁻⁹ cm⁻²s⁻¹</td>
<td>3×10⁻⁹ cm⁻²s⁻¹</td>
</tr>
<tr>
<td>Source Location Determination</td>
<td>&lt;0.5 arcmin</td>
<td>&lt;0.4 arcmin (ignoring BACK info)</td>
</tr>
<tr>
<td>GRB localization</td>
<td>&lt;10 arcmin</td>
<td>5 arcmin (ignoring BACK info)</td>
</tr>
</tbody>
</table>
Risk Management
Risk Management Activity

• No new issues
## Top risks to cost

<table>
<thead>
<tr>
<th>ID #</th>
<th>Risk Rank</th>
<th>Risk Description</th>
<th>Risk Mitigation</th>
<th>Status</th>
</tr>
</thead>
</table>
| Proj Mgt - 005 | Moderate  | Parts and vendor orders have not been completed therefore flight production cost may exceed projection | • Manufacturing engineer added to expedite minimum cost closure  
• Clarification and purchase package review to ensure accurate bids | • Processes in place  
• Remaining vendor selections by 11/03 |
| Proj Mgt - 006 | Moderate  | Critical skilled positions (senior personnel) required to execute project remain open, potential impact to cost and schedule if not closed in short term | • Management team has identified critical skill needs  
• Identify skilled personnel within Collaboration environment | • Added SLAC Site Rep in Italy  
• Added Scientist to Tracker Team & Proj Eng  
• 2 New S/W Engs added 10/03, 3rd in work  
• Identified additional QA support requirements  
• Adding additional Structural analyst support |
## Top risks to schedule

<table>
<thead>
<tr>
<th>ID #</th>
<th>Risk Rank</th>
<th>Risk Description</th>
<th>Risk Mitigation</th>
<th>Status</th>
</tr>
</thead>
</table>
| Proj Mgt - 003 | Moderate | Completion of Tracker subsystem qualification program delayed due to EM closure or MCM electronics | • Manufacturing Eng assigned to close MCM issues  
• Increased team integration with Italian partners  
• GSFC audit/support to Tracker EM closure | • 50 Unit Pre-production run established with Teledyne, ECD: 3 Nov start, Jan 04 Finish  
• Engineer (Dave Rich) added to drive closure |
| Proj Mgt - 002 | Moderate | ASIC’s fail to meet requirements; results in schedule impact                      | • Focused review & test. Margin for re-runs protected where possible  
• Individual risks Identified by subsystem | • DAQ ASIC’s flight ready, continued testing  
• Tracker GTRC error found, on issues list  
• Cal/ACD ASIC’s continued testing |
| Proj Mgt - 004 | Moderate | TEM Power supply final design is delayed, final implementation may exceed current schedule | • Key focus item identified for DAQ  
• Design peer review 9/03  
• Basing approach on flight proven designs where possible | • Peer review completed 9/22/03  
• Re-baselined, tight schedule for EGSE |
| SE-007  | Moderate  | Critical component failure post LAT integration requiring de-integration impacting cost & schedule | • Extensive use of EM test bed to support flight H/W & S/W development  
• Thorough qualification and acceptance tests  
• Pre planned I&T actions for de-integration | • LAT Assembly plan under update to incorporate EM1 lessons learned,ECD: Jan 04 |
4.1.2 Cost & Schedule Status

- **Cost variance - $373K**
  - $150K delay in subcontract billing cycle through Stanford
  - $95K expenditures transferred to IOC
  - $108K underrun in ONE support cumulative, additional staff in-work
  - $20K cumulative SLAC underrun

- **Schedule variance – On track/LOE**
3-Month Milestones

- Update the LAT-MD-00408 LATPVP – October - December
- Support Fault Management TIM - 26 August Kick-off, on-going
- Support STOP Analysis TIM’s - On going
- Complete FMEA – November (Pending Power Supply Design)
- Complete Power Supply Review – Completed 22 Sept
- Complete Cal Grid Review – Completed 23 Sept
- Add ICD requirements to DOORS – Complete, maintenance ongoing
- Complete Spacecraft ICD Review – Completed, TBX closure in work
- Refine risk program - October
- Close remaining Internal ICD TBX’s - October
- Update System Metrics – Completed this month (Next update in January)
- Complete X-LAT Review – 30 October (now 5 Nov)
- Complete CIDL update – 30 October (now 15 Nov)
- Hold EM Test & Qualification Readiness Reviews – TBD (Re-plan)
- Close all open RFAs – October->December