Mechanical Systems
Mechanical / Thermal Hardware
August 2005 Status

Marc Campell, Subsystem Manager
SLAC Status
Grid Qual Static Load Test

- Hardware
  - Grid Box assembly is 99% complete, ECD 9/30/05
- Pre-Test (SLAC activities)
  - Test Interface Plate (TIP) Assembly complete less strain gage application which will be done at NTS now
  - Need to return Spectrum’s Interface plate by mid-Oct.
  - Shipping container for Grid 2 on TIP is in house
  - Ship to NTS 10/7 (after crane repair)
Grid Qual Static Load Test (cont)

- **Test (NTS activity)**
  - Component flexure test required to proof load flexures prior to integration with the Flight LAT on the Test Interface Plate has been added to NTS SOW
    - Test performed on TIP assembly prior to SLT
    - Flexure strain gages also characterized for LAT sine vibe testing
  - NTS’ purchase order has been updated
  - Due to facility conflicts at NTS, they have opted to perform the test in an area that requires a large baseplate (9’ x 9’ x 3” thk steel) to be fabricated.
  - The Grid Box and NTS load frame will be mounted to this.
  - This gives us better access to the test article and it will allow faster set up changes to configuration.
  - The down side is that it will take 5 – 6 weeks to fabricate the baseplate (ECD 10/24).
  - The test would start 3 days after completion of the baseplate.
# Grid Qual Static Load Test Schedule

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
<th>Predecessor</th>
<th>Res Quarter</th>
<th>2nd Quarter</th>
<th>3rd Quarter</th>
<th>4th Quarter</th>
<th>1st Qtr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware (SLAC)</td>
<td>106 days</td>
<td>Wed 5/4/05</td>
<td>Fri 9/30/05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering/Procurement (SLAC)</td>
<td>45 days</td>
<td>Mon 3/7/05</td>
<td>Fri 5/6/05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test (Supplier)</td>
<td>164 days</td>
<td>Mon 5/9/05</td>
<td>Mon 12/26/05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contract Award</td>
<td>1 day</td>
<td>Mon 5/9/05</td>
<td>Mon 5/9/05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Fixture design &amp; Fab (TBR)</td>
<td>31 days</td>
<td>Tue 5/10/05</td>
<td>Mon 10/24/05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Procedure draft</td>
<td>15 days</td>
<td>Tue 5/10/05</td>
<td>Tue 5/31/05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>SLAC review/approval</td>
<td>5 days</td>
<td>Wed 6/1/05</td>
<td>Tue 6/7/05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Procedure released</td>
<td>10 days</td>
<td>Wed 6/8/05</td>
<td>Tue 6/21/05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Receive test article from SLAC</td>
<td>0 days</td>
<td>Fri 9/30/05</td>
<td>Fri 9/30/05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>SLT test readiness review</td>
<td>0 days</td>
<td>Wed 10/12/05</td>
<td>Wed 10/12/05</td>
<td>19FS-3 day</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLT Operations (prep &amp; test)</td>
<td>20 days</td>
<td>Fri 10/28/05</td>
<td>Thu 11/24/05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20FS+3 day</td>
</tr>
<tr>
<td>Static Load Test Complete</td>
<td>0 days</td>
<td>Thu 11/24/05</td>
<td>Thu 11/24/05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>SLAC OK to tear down</td>
<td>2 days</td>
<td>Fri 11/25/05</td>
<td>Mon 11/28/05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>Write SLT test report</td>
<td>20 days</td>
<td>Tue 11/29/05</td>
<td>Mon 12/26/05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24</td>
</tr>
</tbody>
</table>
Drawing Release Plan

• 66 of 73 (90%) drawings released
  – 3 MLI drawings (in check)
  – 4 shims/spacers not needed until Radiator fit check (in check)

• Known drawing revisions
Concerns

- Lockheed Martin - Radiator delivery schedule
  - See LM presentation
- Completion of Grid Thermal Control System hardware installation delay until Sep 05.
  - Heater bonding fixture trials successfully completed
  - Heater installation complete
Open Flight Design Issues

• Radiator integration sequence
  – Coupon testing of repeated make & break of joint has been tested. Results were inconclusive due to test facility problems.
  – Test will be repeated at NTS
  – Disassembly facilitated by use of mold release agent

• Radiator vibration requirements
  – Sine vibration testing will not be performed at LM
    • Test options under investigation
## MECH Qualification Program

<table>
<thead>
<tr>
<th>Qual Test</th>
<th>Status</th>
<th>ECD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-Top Flange Heat Pipe bond process qual</td>
<td>Complete. Report released</td>
<td>Comp</td>
</tr>
<tr>
<td>Grid Box Assy Static Load test</td>
<td>Planning in work. Perform on Grid #2</td>
<td>Nov 05</td>
</tr>
<tr>
<td>X-LAT Plate Thermal Vac test</td>
<td>Complete less MRB on final results</td>
<td>Comp</td>
</tr>
<tr>
<td>Radiator Variable Conductance Heat Pipe new extrusion</td>
<td>Passed burst test, heat capacity test after charging</td>
<td>Comp</td>
</tr>
<tr>
<td>Radiator Acoustic</td>
<td>at LMMS</td>
<td>Comp</td>
</tr>
<tr>
<td>Radiator Thermal Vacuum</td>
<td>at LMMS</td>
<td>Comp</td>
</tr>
<tr>
<td>TCS-Radiator Thermal Balance</td>
<td>at LMMS</td>
<td>Comp</td>
</tr>
<tr>
<td>Radiator Sine Vibration</td>
<td>Test alternatives in work</td>
<td></td>
</tr>
<tr>
<td>Radiator Heat Pipe Thermal Joint</td>
<td>Continue coupon tests at NTS</td>
<td>Oct 05</td>
</tr>
</tbody>
</table>
Radiator Sine Vibe Test Approach

Requirement

2. The primary objective of the high-level sine vibration test is to exercise the radiator interfaces to 1.25 x CLA. The dynamic response of the radiator in its test configuration should be verified in the pretest analysis. If the provided sine vibration input spectrum does not produce adequate reaction forces, the vibration spectrum in the low frequency band should be increased to compensate.

Approach

- Analysis shows that the interface loads normal to the panel (Y-axis) were enveloped by the Acoustic test
- Acoustic test had a flight-like Radiator Mount Brackets
- Propose performing static load test to address the in-plane (X and Z axis) loading requirement
Static Load Test Proposal

- Radiators would be mounted to flight like interfaces on the Acoustic test fixture
- Load fixtures would mount to handling inserts on the X sides of the panel
- Panel is sequentially loaded in +X, -X, +Z and –Z directions (or pull at –Z corner to produce shear load and moment at RMB interface) TBR
- X loads are approximately 200 lbs
- Z loads are approximately 200 lbs
- Handling insert coupons were tested in shear and B basis capability is 800 lbs TBR (just need to verify)
Glaster LAT Project Mechanical Systems

Static Load Test Test Configuration

- Frame Simulating the S/C Bus
- X
- Y
- +Z
- Loads
- Struts 4x
- -Y Radiator
- Flight like brackets from SLAC (dye penetration tests run with no issues found)
- Pedestal not available
- Frame would be bolted to I beams on floor
Requirement 1

1. The Radiators shall be capable of full operational performance after exposure to the sinusoidal vibrations loads due to the launch environment shown in Table 11a. This is specified in the IRD requirement, which reiterates Goddard Space Flight Center (GSFC) policy that sine vibration testing is performed only up to 50 Hz. Notching of the test levels shown is allowed to avoid over-testing of the structures.

Approach

• Waiver would be required for this requirement
Requirement

3. In order to address any vulnerability to the MECO high frequency (110 Hz – 120 Hz) event, the LAT and all subsystems will conduct a low-level sine sweep test to identify all resonant frequencies up to 200 Hz. This low-level sine sweep spectrum for the LAT and all subsystems is shown in Table 11b.

Approach

• Analyzing Acoustic test data including tap testing to determine if modes can be identified.
  – Preliminary check looks promising
  – Also need damping (Q) factor
• If modes were not identified then need to investigate test approach
  – Modify tap test?
  – Modal test?
  – Note Radiators are not installed during LAT level vibration testing
• Waiver required to explain how the data was arrived at if not by sine sweep?
Next Steps

• Agree on test approach
  – Received comments back on chart package
  – Set up telecon to discuss open issues
• Arthur Scholz will detail out Static Load Test implementation
• Conduct TRR
• Process required waivers
Cost/Schedule Reports for 4.1.8 Mechanical Systems Presentation
August 2005 Month End
# Level 3 Milestone List

<table>
<thead>
<tr>
<th>Activity Description</th>
<th>Baseline Finish</th>
<th>-2m Var</th>
<th>-1m Var</th>
<th>Bsln Var</th>
<th>Early Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight Grid RFI-Mech to I&amp;T</td>
<td>03/23/05</td>
<td>-5</td>
<td>-5</td>
<td>03/30/05A</td>
<td></td>
</tr>
<tr>
<td>X-LAT Thermal Plate RFI from Mech</td>
<td>04/20/05</td>
<td>-65</td>
<td>-65</td>
<td>07/22/05A</td>
<td></td>
</tr>
<tr>
<td>Radiators ready for I&amp;T (from Mech)</td>
<td>07/22/05</td>
<td>-36</td>
<td>-41</td>
<td>09/20/05</td>
<td></td>
</tr>
</tbody>
</table>
Milestone Variance Explanation

Radiator RFI -41 days

• Schedule Impact
  – No impact to LAT schedule

• Cost Impact
  – $540K change request is in process for funds to complete test program and ship hardware
## GLAST LAT Project Mechanical Systems

### Cost Report

**Monthly Contractor Financial Management Report**

**31-Aug-05**

**NASA form 533M**

**Report for Month Ending:** 8/31/2005

<table>
<thead>
<tr>
<th>Reporting Category</th>
<th>Cost Incurred</th>
<th>Estimated Cost</th>
<th>Estimated Final Cost</th>
<th>Unfilled Orders Outstanding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>During Month</td>
<td>Cum. to Date</td>
<td>Detail</td>
<td>Balance of Contract</td>
</tr>
<tr>
<td></td>
<td>Actual</td>
<td>Planned</td>
<td>Actual</td>
<td>Planned</td>
</tr>
<tr>
<td>4.1.8 MECHANICAL SYSTEMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1.8.1 MANAGEMENT</td>
<td>297</td>
<td>85</td>
<td>4,407</td>
<td>3,794</td>
</tr>
<tr>
<td>4.1.8.2 RELIABILITY &amp; QUALITY ASSURANCE</td>
<td>0</td>
<td>0</td>
<td>399</td>
<td>393</td>
</tr>
<tr>
<td>4.1.8.3 MECHANICAL SYSTEM DEVELOPMENT</td>
<td>0</td>
<td>0</td>
<td>1,088</td>
<td>1,088</td>
</tr>
<tr>
<td>4.1.8.4 THERMAL SYSTEMS DEVELOPMENT (LM)</td>
<td>0</td>
<td>0</td>
<td>1,043</td>
<td>1,043</td>
</tr>
<tr>
<td>4.1.8.5 THERMAL CONTROL SYSTEM (SLAC)</td>
<td>45</td>
<td>108</td>
<td>760</td>
<td>849</td>
</tr>
<tr>
<td>4.1.8.6 RADIATORS, HEAT PIPES, THERM TEST, X-LAT (L)</td>
<td>-128</td>
<td>59</td>
<td>7,498</td>
<td>7,797</td>
</tr>
<tr>
<td>4.1.8.7 GRID</td>
<td>0</td>
<td>0</td>
<td>656</td>
<td>640</td>
</tr>
<tr>
<td>4.1.8.8 FABRICATION, ASSEMBLY, AND TEST</td>
<td>134</td>
<td>235</td>
<td>655</td>
<td>944</td>
</tr>
<tr>
<td>4.1.8.9 LAT I&amp;T SUPPORT</td>
<td>0</td>
<td>13</td>
<td>0</td>
<td>103</td>
</tr>
<tr>
<td><strong>CAPW[3]Totals:</strong></td>
<td><strong>347</strong></td>
<td><strong>500</strong></td>
<td><strong>16,504</strong></td>
<td><strong>16,650</strong></td>
</tr>
</tbody>
</table>
Cost Variance Explanation

• Why overrun/underrun?
  – LM has overrun their contract

• What will be done to correct?
  – Additional funding required
FTE Variance Explanation

• Why overrun/underrun?
  – Delay caused by late start of Grid Box #2 assembly work

• What is the impact?
  – Delay in Grid Static Load Test
  – No LAT impact