Notes from the CAL-GRID closure meetings starting June 2, 2003

Notes from June 2 meeting are in red.
Notes from June 3 meeting are in blue.
Notes from June 4 meeting are in green.
Notes from June 5 meeting are in purple
Notes from June 9 meeting are in orange

Notes:

Discussed John Ku’s initial results. Marc will proceed with the completion of the 1x4 grid. Marc e-mailed Tapemation to re-start work on the 1x4. He is awaiting a schedule for completion. Marc is planning to build EMI Skirt pieces for the 1x4. He will wait for the final configuration of the skirt pieces after the boss designs have stabilized (ECD: 13 June 2003)

This process will be far enough along by June 19 so that the bid drawings for the 4x4 can go out by June 26.

Eric G. brought up the need for a verification plan that would convince Goddard and LAT I&T that the injection of epoxy meet requirements.

1. Requirements
   a. Need to settle with GSFC people as to when friction can be included – Mike has updated the analysis plan. Needs to discuss with Martin. There is internal SLAC and Tiger Team agreement on the analysis plan, but we are waiting for the structural analysis to re-start before the plan is finalized.
   b. Strength Qualification Plan – Martin is working it. This is a few pages for the instrument. Draft will be sent to Larry today. Martin distributed copies and will send to Larry today. Get any comments back to Martin.

2. Design
   a. Details at the spacecraft attachment point – Mike is working on the “tongue and groove” approach. The sandwich approach is the backup and will require match drilling. The tongue and groove plates next to the spacecraft attach points are laid out. Mike Foss is looking at the other locations. There are two concepts on the table. One is the sandwich, which Mike is working with Scott Dow. They are discussing whether the pin in the spacecraft mount goes through the plate and into the grid or does it just go through the plate. The other is the tongue and groove. Mike showed an updated version that adds material to the plate rather than the Grid to make up the difference in height. The result is that the “tongue” can be moved further away from the edge on the grid, increasing tear out strength. Mike F. has completed the conceptual design of the SC boss and shear plate. This includes adding a 7/16” shear pin and keys, and thickening the boss to 15 mm. Bill Olson thought that the Grid alum billet could accommodate the 15 mm boss. Consensus was to reduce it to 13 mm everywhere, to align with the SC interface height. Mike F. will check
that this does not produce an interference with the tab bolts. The working
decision of using 13 mm was reaffirmed. Mike F. is working on draft
files to check dimensions.

b. **Details at the other attachment points** – Mike Foss showed some
illustrations for concepts in the corners next to the radiator mount
brackets. This looks doable with a key concept but would require some
modification to the radiator mount. Mike F. will look at the quarter point
attachments next. Mike F. showed illustrations that showed that the plates
can be fit in if some material is removed from the EMI skirt. He will
continue to work on details. The Qtr-Point boss conceptual design is
complete. This requires notching of the EMI Skirt under the bulkhead
connector plate. Mike F. will check on clearance to the connectors and
cables with this design. Bill Olson will look at impact that notching has
on the EMI Skirt piece, but it looked like only minor changes would be
needed. The corner boss design is stable, but there was discussion about
the tolerances needed to ensure good fit with two keys at 90 degrees to
each other. There are a few options to sidestep this problem, and any
potential interference with the Radiator Mount Bracket, however the
consensus was to hold off on the design work until the rough sizing
analysis is complete.

c. **Material** – Mike is checking with NRL which aluminum alloy they are
going to use for the base plates machined in the US. The best estimate is
that high strength material such as titanium will be needed at the 8
periphery locations but that aluminum can be used at the center locations.
Final determination awaits the load analysis.

d. **NRL concurrence** with changes to base plate – Mike has sent PowerPoint
charts and will discuss with them 6/2. Mike is setting up a conference
call. The conference call will occur on Thursday. Mike M. and Martin N.
telecon’d with Paul Dizon, Oscar Ferreira and Bill Rainer from the CAL.
They thought that they could accommodate the pins in the corners, and
will investigate options for the design and placement of these pins.
Subsequent to the telecon, Mike F. sent rendered JPEG’s of the shear
plates to the CAL group for review. There will be a follow-up telecon on
Wed June 11 at 8:00 am PDT. Marc Campell needs dummy CAL plates
soon; the group decided that he should fab the current baseline design,
then cut off corner tabs, if needed. Since these will be for fit-checking
only, they don’t need to be fully faithful to some subtle details needed for
developing full strength on the shear plates.

3. **Analysis**

a. **Instrument FEM** -- Yousef is working on the integrated model. He will
review the results with Martin when problems resolved. Martin will
review the results with Yousef on Thursday morning and report at the
11:00 meeting. Done: Youssef I. and Martin N. reviewed modal
frequencies and mass participation for 7 different models, from the dPDR
model up through the updated Grid model with and without shear plates
and CAL tab friction. The trends on frequency were as expected, and the
model was now predicting a “potato chip” mode, which was seen at dPDR, but lost in the earlier CDR models. This is all good news, suggesting that the model is ready for use. Next step: John Ku will start the shear plate analysis with Mike M., and Youssef I. will continue model checks on the integrated model, then look at tab friction shear loads. Youssef is working on renumbering nodes in the model. This is needed for clean communications with the subsystem and with the project office. John Ku is working with the model as is to find interface loads at all of the peripheral locations. His first pass uses the same plates everywhere. This will give us more confidence that the working design is adequate. After the design is frozen, he can repeat the calculations.

b. **Second order effects** due to this shear path being separated from the original interface plane – TBD

c. **Modeling of the pin** – What is the proper model? John Ku took a first pass using a standard aircraft model. This was questioned for this application. Mike has looked at the hole tolerancing and it looks like 0.015 inches will remain as the tolerance between the pin and the hole in the CAL plate. Can we verify the model at the pin by a new version of the cantilever test? Mike has looked at the “worse on worse” tolerance case and it still looks like 0.015 inches will work. The issue of what to do in I&T if the as built arrangement doesn’t fit was discussed. One straightforward remedy is to custom make a plate for that location. Also, it was noted that the Menning plates need to be included in the testing with dummy Cal plates.

4. **Testing**

a. **Testing under vibration** – Tests thus far show that pinned joint is in the linear region and such testing may not be required. Our test machine is not set up for vibration or “fast” testing. If required, we should check with SRI.

5. **Integration and Test**

a. **Access** – Preliminary look at access for installing plates and injecting epoxy is that it is doable. Further review is required after design chosen.

b. **Verification** – Concern about ability to verify there are no voids in the epoxy. Plan is to verify by test program.

6. **Closure for the task force**

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<thead>
<tr>
<th>Item</th>
<th>Exp. Date Complete</th>
<th>Driver</th>
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<tbody>
<tr>
<td>1. Conceptual Drawings</td>
<td>Mike F. will start these now. He may have rough drafts for the June 9 Tiger Team</td>
<td>Mike Menning</td>
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<tr>
<td>2. Update shear requirement in the environmental specification</td>
<td>Youssef I. will start tab shear analysis shortly. This is first step in updating Env Spec loads</td>
<td>Martin Nordby</td>
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<td>3. Approved LAT Test</td>
<td></td>
<td>Martin Nordby</td>
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<tr>
<td>Plan</td>
<td>4. Approved Analysis Plan for this issue</td>
<td>Mike Menning</td>
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<td></td>
<td>5. Analysis showing positive margins</td>
<td>Mike Menning</td>
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<td>6. Concurrence from CAL</td>
<td>Mike Menning</td>
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<td></td>
<td>6/11 telecon planned to review concepts</td>
<td>Mike Menning</td>
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<td>7. Concurrence from Spectrum Astro</td>
<td>Dick Horn</td>
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<td>Per 6/5 Spectrum WG telecon, they are still carrying the sandwich option for the SC-LAT interface. ETA for LAT to drop this option is after initial shear plate analysis</td>
<td>Dick Horn</td>
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<td>8. Schedule through Grid fabrication</td>
<td>Jim Martin</td>
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<td>9. I&amp;T Review</td>
<td>Eric Gawehn</td>
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Notes from the May 19, 2003 meeting on the CAL-GRID interface.
Notes from May 20 meeting in red.
Notes from May 21 meeting in blue.
Notes from May 22 meeting in green.
Notes from May 23 meeting in purple.
Notes from May 27 meeting in pink.
Notes from May 28 meeting in brown.
Notes from May 29 meeting in spring green.
Notes from May 30 meeting in Turquoise

Future meetings will be held daily at 11:00 until further notice.

Mike Menning presented his current design and the status of testing. This design is based on shear plates at each intersection of CAL plates and along the edge. The edge plates connect to a new feature on the grid wings that comes up to the plane of the shear plate.

This is our working solution to this interface

Mike presented the following issues:

1. Repeat strength test with titanium plate. Mark Molini – Friday 5/23 on schedule
   Titanium should be at machine shop today. A plate made from 5/16-inch plate is in the test machine. The instrumentation needs to be checked. Two 3/8 inch plates (the planned plate thickness) are in hand and will be tested Tuesday 5/27. Have data from first plate (5/16 thickness plate and 3/8 inch bolt). Residual displacement down by a factor of ~2. 4000 lbs on one bolt < .001 displacement. Second plate data waiting for thermal equilibrium. Finished second plate looked like first plate. Done. Titanium (maybe even SS) presents a re-entry issue if the pieces are too large; Art Whipple will check with GSFC experts to determine largest dimension that will not pose an issue. High-strength Al may be sensitive to stress-corrosion cracking, so Ti or SS are highly preferred. Ti has had a quick look by GSFC and it looks marginal. Mike Foss looking at shapes. Mike Menning is going to contact NRL and find out what Al aluminum alloy they are going to use for the CAL plates in US.

2. NASTRAN loads and frequencies
   a. Plates into NASTRAN – John Ku – 5/20 on schedule. Required additional work on the model but Yousef and John are working the issue and will keep on schedule. The first look at the results gave 53.6 Hz for the drumhead frequency, which was the lowest mode. The model was missing a connection file and John simulated those connections as welded connections. He will get the missing file from Yousef and rerun the analysis. What if results will be available tomorrow. Results that are adequate to validate this design approach will be available by COB, Wednesday, May 28, 2003. The ACD is connected to the model properly
now. The tracker interface will be updated in the model this afternoon. Still on track for numbers by Wednesday 5/28. Yousef says still true. An hour after the meeting he will have the model running. Sit with Martin today. Numbers tomorrow. Fidelity problems with the model. Comparable cases. Hope to resolve the model today. Yousef is still working on this. Yousef is still working on this but can’t figure that out.

b. Update tabs – John Ku – 5/23 on schedule This work has higher priority than adding the details of the plates next to the spacecraft mount. Completion still on track for Friday, May 23, 2003. Complete. On second run now. They are incorporated. Closed. No change.

3. NRL concurrence with design change to base plate. Mike Menning will send a more accurate description of the design to the CAL team. Mike will prepare PowerPoint presentation today and send to NRL. Mike will follow up on Monday.

4. Details of wing attachment – Marc Campell will organize a meeting with designers to work the concepts. This meeting occurred and work is underway. Initial drawings available Wednesday. The only issue uncovered was the plate adjacent to the spacecraft mount. The original concept interferes with the Tracker cables in that area. Mike Menning and Martin Nordby have a concept. They will discuss this with the Spectrum-Astro people that are here for the Mechanical TIM. The meeting took place. The spacecraft interface could be moved in the –Z direction to allow for a “Menning Plate” to be sandwiched between the spacecraft flexure and the mounting plate on the grid. This is possible but not desirable because it adds an additional interface in that primary load path. The spacecraft interface could be moved outboard but that is problematic for both the spacecraft and the LAT. It would increase the moment in the Grid sidewall due to the offset thrust. A half-inch might be possible. Mike Menning presented some concepts he had which maintain the single interface to the spacecraft and the plate attaching to the grid using a pinned tongue and groove joint. This approach looks promising. Call Tapemation today regarding groove. Check with Scott Dow regarding the “sandwich” design. Look at the “tongue and groove” approach at all external plates. Mike wants to look at a V groove as an alternate that would be more manufacturable. Mike M. reviewed this with Jerry C; original channel design is not more difficult. Marc proposed a key/slot concept; he’ll review this with Mike prior to tomorrow’s meeting. Martin N. raised a new issue relative to the S/C attachment point: the shear plates at those points would need to be match drilled. This needs to be resolved before the GRID can be machined, though this is not a big deal.

Martin Nordby raised the following issues:

1. Second order effects due to this shear path being separated from the original interface plane. No change.
2. Flange and web not connected by these shear plates No change.
3. Need to settle with GSFC people as to when friction can be included – modal analysis, stress analysis, coupled loads analysis, etc. Mike M. and Martin N. will
update analysis plan and release before tomorrow’s meeting. Mike updated the
analysis plan. Larry was in concurrence with the revised plan. Need to talk to
Martin.

4. Interface loads for Tracker and ACD go up without friction in the analysis. These
may be bracketed by existing design but needs analysis. No change.

Need to resolve open issues with the NASTRAN model – Yousef Ismail – 5/23 on
schedule Yousef is working this issue and expects to close the issues by Friday. The
model will be ready as planned. Martin will audit the results and the audited model will
be ready by the end of Tuesday, May 27 along with a list of liens against the model.
Martin has planned meeting to review the model on Tuesday (5/27) morning. This will
happen this afternoon. They did meet and identified some issues. They will review again
today. Yousef still working this.

Need to resolve requirements using loads based on 6 degrees of freedom.

1. Generate rational loads based on 6 degrees of freedom – done
2. Develop credible test plan – Martin Nordby 5/23 on schedule Draft is done and
Martin is working the details. Have test loads. Looks like 2.9 G lateral. Use
static test to qualify joints / GRID. Martin will have a draft ready to discuss with
the tiger team. Hope to review loads with tiger team today. Martin did review
this with team today, received qualitative approval, Martin will write it up and
send it to Larry M.: Larry plans to review the status of this with other GSFC
experts. Martin is updating his table.
3. Validate (1).

Review I&T sequence with the new design to look for issues that will need to be resolved
before adopting this approach – Eric Gawehn Eric Gawehn will write up the I&T issues
by Friday’s meeting (5/23). Eric made his presentation (see attached notes). The added
plates do add additional steps which will take training and time. He did not find any
show shoppers. We discussed plans to verify that there are no voids in the epoxy. The
plan is to run enough samples to ascertain that the process can be controlled in volume,
injection rate, external inspection, etc. to assure no voids. Closed. Larry M. may know
of a relevant GSFC document for Martin to review regarding tolerances for pinned joints.
Sidebar: there is a conflict between the EMI skirt and TKR cable connector during CAL
module integration, but it is not relevant to the Cal-GRID interface design. Martin N and
Mike Foss will address this after the EMI skirt design settles down.

Eric has an alternate suggestion for the pins. He will discuss with Mike Menning and
then distribute a brief description.

Dick Horn will work on getting the recent CLA from GSFC although this will not have a
major impact on this analysis. Dick is working the issue. This is not an issue for closing
on this design. No change: Sharon has not yet responded to Art Whipple.

The layout of plates at all locations needs to be checked to assure that there are no
interferences with the plates and/or installation. Thus far the only obvious problem has
been in the region of the spacecraft mount and that has been modeled well enough to understand the issues. Marc Campell will have the designers model the other locations well enough to confirm there are no serious problems. Work on that after this meeting.

Quick look. Need to look more at area around the radiator mounts. Marc and Martin will talk to Mike Foss about the issue. If problems are uncovered, they should talk to Mike Menning about alternate mounting techniques. MN and MF have begun conceptual design of all perimeter Menning plate joints. Mike Foss is working.

Jim is working with Marc and Martin to list the activities necessary to get the GRID on order. Then they will add dates to the sequence. This is a bottoms up schedule that will result an estimated delivery date for the tested GRID assembly to I&T. They will present their results by the close of business Tuesday, May 27. The list is in draft form with dates. Marc and Jim will check on the dates and are on schedule for 5/27. Need chart by the time the tiger team leaves that shows key dates and responsibilities through the delivery of the GRID to I&T. Art and Dick are preparing chart. A closure on the analysis and test plans is required to complete the schedule issues. Marc needs to review the pre-RFP activities list to determine which few things must be closed before the RFP package can be submitted to Purchasing. Lowell, Martin, Jim & Marc will prioritize on Monday.

Mark distributed information on expandable bolts as a potential alternative to epoxy. The issue is their tolerance to misalignment of the holes. Do plan to order expandable bolts, but there is no definite testing plan yet. MM/MN both worried this approach could require a large analysis and EM effort.

Open issues:
Tolerances on the holes.
Look at other locations.
Agreement on an analysis plan and a test plan. Mike will send revised analysis plan before tomorrow’s meeting; Martin will send out revised test plan by Thursday.

Mike looking at Cal Grid interface drawings to look at tolerances on the bolts and holes.

L. Klaisner/J. Martin
6/10/03
Problem Description
- Negative strength margins at calorimeter-grid interface

Status
- GSFC/SLAC tiger team established for review, oversight, and support
- Design enhancement identified (shear plates)
- Initial analysis indicates significant margins
- Coupon tests to date support analysis
- Detailed analysis and test plans in-work
- Initial I&T impacts assessed and accommodated
- No known show stoppers

Closure Plan
- Update and complete FEM, 6/15/03
- LAT design integration implementation complete, 7/1/03
- Complete critical design analysis, 7/30/03
- Complete detailed design, 8/30/03
- Evaluating availability of additional resources to maintain schedule