Semester Team Reviews
Spring 1998

Reviewers' Comments

Subject: Power Generation and Distribution Review
Date: Thu, 7 May 1998 10:47:20 -0700 (MST)
From: Bill Sandel <sandel@argus.lpl.arizona.edu>
To: KC Hsieh <hsieh@space.physics.arizona.edu>
CC: Bill Sandel <sandel@argus.lpl.arizona.edu>, ssp-admin@physics.Arizona.EDU

Power Generation and Distribution Review 30 April 1998
Ramblings
Bill R. Sandel 7 May 1998

I was impressed that much work and thought have gone into the design of the power system. However, a number of important questions need to be addressed before the design is ready to progress to the PDR phase.

1. Need to get a better idea of the power that will be required by the subsystems. Remember to include a big contingency or margin in designing to these requirements, because estimates of subsystem power almost always increase with time.

2. Need a system-level decision on the best way to distribute power. The present plan to distribute regulated +28 VDC is probably not the best approach. This is because most subsystems will use voltages such as +5 VDC and +/-12 VDC, so they will need to have their own convertors (and hence regulators). This would mean two steps of regulation, almost certainly wasteful. Possibly better approaches are:

   a) Distribute unregulated +28 VDC, say +/- 5 or 6 volts, permitting noise, spikes, ripple, etc. Let the customer subsystems convert and regulate this to whatever they need.

   b) Distribute regulated power at +5 V, +/-12 V, or whatever the subsystems need.

3. Remember that the power system will need to accommodate the transient loads that will occur when subsystems switch on. This often makes it hard to work with the option b) (regulated power) in the point above.

4. Need more information (at least more than was presented in the review) about the energy storage capacity of the battery, and how this affects charge/discharge cycles, the observing plan, etc.

5. Need more input from orbit dynamics and attitude control studies to determine if it really makes sense to place solar cells all around the bus. Maybe some of these cells will never be illuminated?

6. Early prototyping of the circuitry will reveal new and interesting information.

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Subject: Semester Review
Date: Thu, 7 May 1998 15:47:39 -0700 (MST)
From: Charles Curtis <curtis@space.physics.Arizona.EDU>
To: John Hsieh <hsieh@space.physics.Arizona.EDU>
CC: ssp-admin@space.physics.Arizona.EDU

Comments on the MSA and GNC reviews:
In general:

(1) Presentations were focused and professional for the most part.
(2) Participants were enthusiastic -- the project appears to be an excellent learning experience.
(3) The teams seem to have an excellent grasp of the scope of their tasks, although the translation of science objectives to engineering requirements isn't complete in some cases.
(4) It appears that much of the component design remains at the concept level, with a lot of breadboarding and hard engineering remaining to be accomplished. The development schedule seems to have slipped noticeably.
(5) It appears that there is considerable variation in the progress by each team, which is understandable given the differences in the personnel and materiel resources available to the teams.
(6) Funding already in place appears marginal. Development of proof-of-concept components and systems appears to be slowed as a result.

Subject: Forwarded mail....
Date: Thu, 4 Jun 1998 11:16:10 -0700 (MST)
From: John Hsieh <hsieh@space.physics.Arizona.EDU>
To: ssp-admin@space.physics.Arizona.EDU, ssp-mentors@space.physics.Arizona.EDU,
SSP-Science <ssp-science@listserv.arizona.edu>

Here I submit my report!

---------- Forwarded message ----------
Date: Thu, 4 Jun 1998 11:14:43 -0700
From: John Hsieh <hsieh@space.physics.Arizona.EDU>

Comments on the Science (SCI) Team Semester Review on 27 May 1998

General comment:
The review, though late in time, was well organized and the presentations well prepared. The readiness for proto-typing this summer with field testing signifies the progress made by the team with the support and guidance from Prof. Thome. As the instrument comes closer to reality, its requirements on the spacecraft (s/c) become more specific. Close communication with all other teams should start ASAP, before mutual requirements and interfacing specifications become a problem.

Specific comments:
1. The use of a cylindrical lens to separate lightning from sprite on a [1] photodiode array is very clever. The effectiveness of this approach will depend on the control and knowledge of the angle between the photodiode array, the length of the cylindrical lens, and the Nadir. The altitude resolution as a function of this angle must be well understood and the requirement on control and knowledge of s/c attitude must be conveyed to the GNC team ASAP.

2. The pointing accuracy required for stellar photometry, considering the .5 X.5 degree FOV and 1 sec integration time, must be conveyed to the GNC team ASAP.

3. The need of a dedicated CPU should be discussed with the DCH team ASAP. This close contact is necessary for optimal use of s/c resources, especially, telemetry and power.

4. There is a preliminary estimate on the power requirement. Keep the PGD team informed of your progress and enter into discussion while things are still fluid. A 10A pulse is not easy to handle.

5. Data format and packetizing require more work. Again, work closely with DCH and TTC teams.

6. Now that SCI and STI teams share the same space in Prof. Thome's lab, this should be helpful in finding the solution to accommodate STI's needs into the SCI instrument design.

7. On the need for machine shop training, there are at least two possibilities: one at AME and one at Physics. SSP-Admin will collect the needs of the other teams before approaching these two resources for arrangement.

Subject: Re: a reminder on Semester Review
Date: Thu, 14 May 1998 12:30:21 -0700 (MST)
From: John Hsieh <hsieh@space.physics.Arizona.EDU>
To: "Matthew R. Jones" <jones@ame.arizona.edu>
CC: ssp-admin@space.physics.Arizona.EDU

Thank you, Matt!
We will see to it that knowledge is not lost. Chris and Brian have deviced a reliable Tech Note system for archiving. And the Teams are complying.
Are you going to be around in the summer? Maybe we can get together to talk about SSP. Stay in touch! Have a good summer!
John

On Thu, 14 May 1998, Matthew R. Jones wrote:

> I attended the review of the MSA (Mechanical Structure & Analysis) team.
> This team has made good progress in developing the skills and learning how
> to use the tools necessary to build and analyze the satellite. However, it
> appears likely that much of this knowledge will leave with the graduating
> students. The team needs to make sure that replacements are recruited
> before experienced personel depart to ensure a smooth transition.
>
>
> >Dear Reviewers,
> >You all must be very busy, especially as the academic year comes to an
> >end. I would take this opportunity to thank you for your participation in
> >the SSP Semester Review. I have one more request to make.
> >
> >Before the semester is over and your memories fade, could you please take
> >a few minutes of your precious time to send me, with a copy to
> ><ssp-admin@physics.arizona.edu>, a short paragragh on your evaluation of
> >the review(s) you attended and your advice to the team(s) you reviewed?
> >Your input will be critical to the next steps the teams take this summer.
> >
> >Thanks again for your help! Have a great summer!
> >
> >John
>
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Subject: (no subject)
Date: Thu, 14 May 1998 14:58:48 -0700
From: "Richard M. Schotland" <rms@air.atmo.arizona.edu>
Organization: Institute of Atmospheric Physics
To: ssp-admin@space.physics.arizona.edu

John,

I was quite impressed with the effort of and the results presented by the laser communication group. The comments that I have to make probably arise from some confusion arising from the limited time that the group had to review their year's progress.

From my standpoint, I would have liked to have seen a quantitative statement of the communication problem. That is, how much data had to be telemetered and in what time period? What are the optical requirements? And what are the trade offs between laser power, optical beam width (and resulting footprint) and beam spatial tracking by the satellite of the ground station?

This quite an ambitious undertaking and you are to congratulated on the progress of the project.

Dick Schotland

Subject: Re: Semester Review
Date: Thu, 7 May 1998 12:07:11 -0700 (MST)
From: Stephen Bell <sbell@lpl.arizona.edu>
To: John Hsieh <hsieh@space.physics.arizona.edu>
CC: Charles Curtis <curtis@space.physics.arizona.edu>,
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My comments for the Power systems:
1. Needs system level requirements from each instrument, including
EMC requirements.

2. An overall system grounding and shielding diagram needs to be
generated also.

3. I saw no justification for the "peak power tracker".

4. Who will provide soft-start for the various instruments?

For the Telemetry:

1. Keep in mind that power efficiency of the transmitter at microwave
frequencies is poor, on the order of 10-50%.

2. I saw no evidence that anyone is working on a design for the RF
circuitry for either the transmitter or receiver.

3. We might be able to set up a test range for the antennas, on campus,
to supplement whatever help will be obtained from Raytheon.

Subject: GNC semester review
From: william-wing@ns.arizona.edu

Here are my comments on the GNC team's semester review. I hope they're useful despite the delay in providing them.

1. GENERAL. The team has done an impressive amount of work and analysis. However, it seemed that sometimes they had difficulty explaining why they had made certain decisions, and equally, why alternatives suggested by the audience were rejected, other than "We've already though of that and it won't work." Some miscommunication may possibly have originated in the terrible acoustics of the AME room the presentation was held in.

2. Pointing accuracy of 1 degree earth-based, 0.1 degree inertial seems adequate to support other teams' needs, if it can be achieved. A confusing statement was that the positioning will be relative to the stars, yet the star sensor contemplated in earlier design iterations apparently has been abandoned.

3. Earth's magnetic field sensor. The team appears to be relying on this system as the primary pointing absolute reference, i.e., to achieve the stated 1 degree accuracy. It is probable that with careful design it can achieve this accuracy, as far as sensing the earth's field is concerned. However, the team seemed to be unaware of the potential problems caused by stray magnetic fields of the spacecraft itself. To avoid angular pointing errors, spurious stray field components perpendicular to the earth's field must be held to 1/100 of the earth's field, or less -- i.e., to less than about 5 x 10^-3 gauss or 0.5 microtesla. Stray fields substantially larger than this commonly exist inside laboratory equipment, caused both by unpaired electrical currents (which may be time-varying) and by residual magnetization of the components. In usual electronic design practice (except in low-magnetic-field research laboratories), the weak-field magnetic environment of equipment usually is ignored. Thus it appears that GNC or someone will have to police all the other teams' design and construction practices to avoid interefernec with the magnetic navigation system. Yet no such program is in place or even seems to have been considered. The systems engineering team which was strongly recommended by both outside professionals and UA faculty at the Preliminary Design Review could take on this job, but it seems to have been abandoned as well.

The star sensor guidance system would not be affected by such problems. The main reason it was abandoned seems to have been to save effort on the part of GNC. In view of the extra effort, in the form of additional design constraints, this decision has created for all the other teams, and the increased risk of mission failure if the requisite policing is not done, I believe this GNC decision should be re-examined.

4. Sun sensors. These were said to have an accuracy goal of 1 to 5 degrees and to be for the purpose of maximizing solar panel illumination. Thus accuracy would be more than sufficient for that purpose; even a 10 degree alignment error causes only a 1.5% reduction in perpendicular solar panel flux, and considering that the panels will be plastered all over the faces of the spacecraft, the net misalignment power reduction is likely to be even less than this. Therefore, for their stated purpose, the sun sensors seem to be overdesigned.

From another point of view, however, they seem to be underdesigned. If their accuracy could be improved by as little as a factor of two -- to less than 1 degree error -- they could be used to provide a valuable independent check and absolute calibration of the tricky earth's magnetic field positioning system, whenever the sun is in view.

Here, it seems, is a second instance of the value of applying a systems engineering perspective to the spacecraft's design.

5. Some further comments on details of the sun sensor design:

A. The sensor design proposed at the review had one axis employing two TI TSL230B programmable intensity-to-frequency converters attached to the faces of a trapezoidal mount. Presumably two orthogonal sensors would be used. There seemed to be no reason why a single mount with 4 sensors on the faces of a pyramid would not work equally well or better,

having improved axis orthogonality and occupying less spacecraft surface real estate.

B. Some difficulty was encoutered in processing the sensor data, i.e., in converting the frequency-coded light intensities of the two sensors to an intensity-independent angular orientation signal. A standard technique to achieve this is to compute the function (A-B)/(A+B). This quantity depends on the intensity difference between the two sensors, but is unaffected by common-mode intensity variations, and hence contains the purely angular information sought.

W. Wing