

Helioseismic Magnetic Imager Program at LMSAL

Contract PY-2223 Progress Report for May 2003

Introduction

This is the eighth monthly progress report on the HMI program at LMSAL. We/LMSAL are collaborators with Stanford University on the HMI/SDO solar physics investigation being led by Prof. P. Scherrer of Stanford University. Phase A began on 1 October 2002 and will last 12 months. A proposal for Phases B-E will be submitted in late June as part of the Concept Study Report.

Summary of Status

Key activities this month included receiving approval from the Project to baseline the reliability enhancements described in prior reports, drafting the PAIP and the Software Management Plan, defining the content of the Concept Study Report (CSR), progressing with defining interfaces to the spacecraft as well as between internal HMI elements, and visiting e2v and RAL to discuss the CCD camera systems. In addition, our team continued to grow and we continued to have weekly SDO Project telecons, weekly HMI-specific telecons, and HMI weekly status meetings.

Schedule and Milestones

The HMI proposal contained a top-level schedule that was based on the dates given in the AO. Now that the program is in full swing, a more detailed schedule has been developed and discussed with the Project. As personnel are added to the HMI team, the schedule in their areas of responsibilities are being refined and expanded. Shown below are some key milestones, with an emphasis on those that will occur in the near term, or have occurred recently (for completeness).

HMI Team (Co-I) Meeting	May 1-2	At Stanford
Visited e2v and RAL	May 15-16	CCD and Camera vendors
Initiate Michelson Study Contract	June	Vendor is LightMachinery
Submit Concept Study Report	June 30	Includes a formal cost proposal
Visit e2v and RAL	July 9-10 (tbc)	PDR-like review at e2v
Host a visit by the Project	July 23-24	Discuss CSR and general status
Status Review	September	At GSFC
Begin Phases B-E	October	
HMI PDR	October 15-16 (tbc)	At Palo Alto

Mission PDR	December 2-4 (tbc)	At GSFC
CDR	July '04	
Deliver HMI to S/C	July '06	
Launch	Aug '07	
Five year baseline mission		

Major Activities During this Reporting Period

With the Observatory SRR/SCR behind us and the Concept Study Report (CSR) staring us in the face, the paper side of the program changed emphasis. After several discussions with the Project, we provided them with an outline for the CSR, received some comments from them, and began writing the report. Much of the effort will go into drafting the CSR appendices, which will contain the major documents and plans for the program. The PAIP and Software Management Plan are now in a relatively mature draft state and the other plans and documents are beginning to receive attention. The schedule is being expanded/updated, and we will soon revisit the program cost estimates. The CSR will be submitted at the end of June and will contain a formal cost proposal for the remainder of the program. It will be discussed with the Project when they visit Palo Alto on 23-24 July.

On the technical side, a major milestone was accomplished when the Project and ourselves established the reliability enhancements that will now be baselined for the instrument. In particular, two redundant tuning motors in the OP, a redundant power system in the HEB, and portions of the control and data handling electronics that will be duplicated in the HEB; along with some level of cross strapping internal to HMI and at the interface to the spacecraft. We will now proceed with a single design that incorporates these enhancements. A purchase order for the RAD6000 boards that will be in the HEB was entered into the procurement system after several discussions with BAE and the LM procurement organizations. Some good exchanges on the details of the 1553 bus protocols took place with the Project, and that interface is now quite mature. We look forward to making similar progress on the high-speed data interface next month.

In the optical-mechanical area we continued to iterate the optics package (OP) configuration towards one that can be frozen and to interact with the Project on how it will be placed onto the observatory. Both aspects seem to now be pretty stable and technically fine; although small details will certainly change as designs mature further. With the optical layout basically frozen, we are beginning to specify the various optical elements to the degree that their procurement specifications can be drafted and the more sophisticated aspects of the specifications can be discussed with potential vendors. The specification for obtaining the Michelson Interferometers from Light Machinery, for example, went through several iterations both to make it technically and programmatically correct and to be acceptable from an ITAR point of view. A trade study was initiated to determine whether to fabricate the OP structure out of honeycomb panels as has been the baseline or to go to a simpler, and less costly and less risky, approach of bolting together machined plates.

Freezing most of the OP internal configuration has enabled us to establish the mechanical properties of the two mechanisms upon which we will perform extensive life tests; the hollow-

core motors and the camera shutters. We have decided to life test 4 shutters so as to evaluate different design details (including lubricant type and bearing preload), and have ordered the piece parts for these shutters. This was possible so early in the program because the housings and encoders are identical to those being used on Solar-B FPP. The hollow core motor requirements, and corresponding design constraints, are now defined to the level that detailed drawings for it are being made and iterated with the vendor – H. Magnetics. We will procure and life test two of these units.

In collaboration with the SHARPP team, we continued to make progress on all aspects of the CCD camera systems. A focal point in this activity was a trip to the UK for a one-day meeting at e2v on the 15th and a one-day meeting at RAL the day after that. Both technical and programmatic topics were addressed and significant progress was made. The concern that e2v had with meeting all of our specifications after going to 5V drive of the serial clocks was mostly eliminated when we decreased the requirement for having summing wells larger than the regular pixels. A few other specifications were fine tuned (decreased) to make both the CCD and camera tasks easier while not distracting from needed capabilities of the camera systems. The viewfoils that were shown at these two meetings as well as a trip report by R. Bush were made available to all members of the camera working group as well as the Project. Interchanges continued by e-mail and on the 30th we had a spur-of-the-moment telecon with NRL. The key aspects of that telecon will also be made available to everyone.

Other Activities During May

1. Several members of the LMSAL team participated in the Co-I meeting that was held at Stanford on 1-2 May.
2. The details of what fixed assets need to be ordered by LM to support the HMI development program matured; the ordering of some items is about to commence.
3. Drafts of the TAAs for LightMachinery and for e2v plus RAL were iterated several times with our local ITAR expert. They were also provided to the Project for information.
4. In response to a request by the Project, we resent several previous messages in a manner that enables them to be clearly seen as action item responses, so the Project can formally close out the actions (provided our inputs were adequate).
5. We provided the Project with a list of needed long lead-time procurements, received their approval to order them, and began to do so.
6. Iteration of the fault tree analysis and reliability block diagram continued and their results were factored into making the decision as to which reliability enhancements to execute.
7. We received useful feedback from the Project on the preliminary EEE parts list we had provided in February and will take actions as appropriate; probably including having a meeting of the Parts Control Board and perhaps a visit by the Project's EEE parts lead. We hope that discussion of potential common buy EEE parts will take place shortly.

8. It was determined that the magnetics used for the FPP filterwheels will work for the 5-position HMI filterwheels, thereby saving on design time.
9. Thermal modeling of the MDI oven with a view towards verifying that model using on orbit data before modeling (and designing) the HMI oven was initiated.
10. We continued to enlarge the HMI team by obtaining a couple of young mechanical engineers who are in a program at LM where they rotate through different groups, as well as a systems engineer who is in a somewhat similar program.

Planned Activities During June

1. Write and submit the Concept Study Report.
2. Establish the dates for the next visit to e2v and RAL – probably 9-10 July.
3. Receive RFAs from the Mission SSR/SCR and prepare responses to them.
4. Continue to increase the size of the LMSAL HMI team.
5. Freeze the optical design and continue drafting procurement specifications for the longer lead time optical elements.
6. Establish, through NRL, a study contract with RAL for the camera electronics design.
7. Submit Technical Assistance Agreement requests to the State Department for LightMachinery and e2v plus RAL.
8. Complete the detailed design of the tuning motors and order two of them from H. Magnetics.
9. Establish a study contract with LightMachinery.
10. Formally submit the HMI PAIP to the Project.
11. Provide the Project with an updated thermal math model of the OP.
12. Host a visit by the Project's EEE parts lead and discuss not only the HMI parts list we provided awhile back but also possible common-buy activities.
13. Continue to participate in weekly Project telecons and HMI-specific telecons, and conduct weekly HMI team meetings.

Design Updates

There was a major design updates this month in that the set of reliability enhancements that we recommended to the Project, and summarize earlier in this report, were accepted. Minor updates to the CCD camera systems, also noted earlier, were made following the philosophy that our intent is to have things “good enough” not best.

Resource Requirements

Attached are preliminary power and mass status updates. These are being provided in a format similar to that used in the last two reports until we learn of a format that is desired by the Project. In addition to now baselining the reliability enhancements, a slight increase in volume/height of the HEB has been included to make adequate room for the relays that will switch between the two redundant power systems.

Issues/Concerns

- The numbers of reviews and additional documentation required by NASA on flight programs ever since the Mars failures make it difficult to put adequate effort into doing “real work.”
- The lack of a UK-provided camera systems puts an additional burden on us and will be a cost impact to NASA.
- Based on past experiences we expect obtaining TAAs will be a lengthy process and may impact our ability to interact efficiently with E2V, RAL, and LightMachinery.
- The launch of Solar-B has slipped a year making the transfer of personnel from Solar-B FPP to HMI more of a programmatic challenge for both programs.



2003-06-04 HMI Power
Report.xls...



2003-06-04 HMI Mass
Estimate.xls...