SWALES AEROSPACE

August 13, 2003

Peter Harvey
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Subject:	**July**	Monthly Report for THEMIS – Bridge Phase Activities THEMIS Progress Report for July 2003 July 2003 Invoice NASA Form 533s
Ref.:		P.O. 1-0000754359 to Swales Aerospace UC Berkeley Contract NAS5-02099
Reporting Period :		**06/27/03 thru 07/25/03**

Dear Mr. Harvey:

Swales Aerospace has enclosed the monthly Technical Progress Report with supporting documentation for activities on the THEMIS program as referenced above. NASA Form 533s have been enclosed in anticipation of the finalization of UC Berkeley Contract NAS5-02099. The original Invoice has been submitted to:

Disbursement Office
400 University Hall
Berkley, CA 94720-1101
USA

If there are any Program questions please contact Michael Cully at (301) 902-4356 or by email: mcully@swales.com. Contractual concerns may be addressed to me at (301) 902-4495 or by email: jmhaas@swales.com.

Sincerely,

J. M. Sims Haas
Sr. Contract Administrator

THEMIS PROGRESS REPORT FOR
July 2003

UC BERKELEY CONTRACT NAS5-02099
SWALES AEROSPACE P.O. 1-0000754359
For the Period **7/01/03 through 7/31/03**

Title: THEMIS Bridge Phase
UCB Technical Monitors: Peter Harvey and Dr. Vassilis Angelopoulos
Swales Manager: Mike Cully

This report summarizes major activities from July 1 through July 31, 2003. Swales provides weekly status informally via scheduled conference calls to UCB management and more frequently as necessary.

I. SUMMARY OF WORK PERFORMED

1.0 WBS 2.2.1.1 PROJECT MANAGEMENT

- Supported a very successful SRR at UCB on July 8th and 9th at UCB. Action items are being worked by Systems Engineering and Subsystem leads. No major issues.
- Completed evaluation of three tank vendor proposals. Presented evaluation to UCB via telephone conference on July 18th. Swales has chosen ARDE to build the tanks pending final negotiations and a plant tour planned for August 7th and 8th.
- Held meetings with the following contractors in support of THEMIS procurements
  - General Dynamics – Single Board Computer
  - Saab –Separation Systems
  - EADS - Reaction Control Systems
- Continued discussions with General Dynamics on Single Board Computer concentrating on part selection, pricing, and delivery schedule. Visited GD on July 23rd and 24th.
- Further developed the detail schedules using Welcom Open Plan.
- Further developed the program deliverable list and submitted to UCB for review and comment.
- Provided to UCB funding projections through August 31, 2003.

2.0 WBS 2.2.1.2 SYSTEMS ENGINEERING

- Supported the SRR.
- Reviewed RFAs and SRR recommendations, and responded to #14 and #25.
- Supported ongoing microprocessor trade study: reviewed Processor board spec and forwarded comments, held discussions with UCB
- Supported ongoing bellyband antenna trade, reviewed antenna specifications
- Supported ongoing Tank Procurement, generated and submitted SCN for UCB approval
- Supported ongoing component procurements including SOW and specification review and site visits
- Supported ongoing separation system trade

- Supported magnetics requirements definition, telecoms, and modeling activities with UCB.
- Supported project planning activities including deliverables list, WBS, documentation lists, etc.
- Prepared comments on draft surface charging specification
- Crafted draft change control form (updated from EO-1)
- Reviewed new mass spreadsheet
- Began Deliverables list for UCB/SAI technical interchange between now and PDR
- Began SEMP discussions with UCB, reviewed existing SEMPS.
- Began writing Generic Instrument ICD (mechanical and thermal), and delivered to UCB.
- Began writing Data deliverables section of ICD.
- Began work on Verification and Environmental Spec. with Mechanical Subsystem
- Supported ACS telecons with UCB including review of submitted THEMIS Error Budgets document.
- Submitted THEMIS Coordinate Systems Specification for UCB review.
- Proposed Revised Propulsion System Requirements
- Initiated Range Safety Requirements Tailoring Effort
- Initiated Formulation of a THEMIS System Safety Program Plan

3.0 WBS 2.2.1.3 Launch Vehicle Interface

- Submitted proposed Agenda for LV Interface meeting kickoff to UCB

4.0 WBS 2.2.1.4 Logistics and Planning

- No activity in this WBS this period

5.0 WBS 2.2.1.5 Design Review

- Jim Barrowman, Art Chomas, and Dan Mark participated in the SRR.

6.0 WBS 2.2.1.6 Quality Assurance

- Supported trip to General Dynamics. Provided suggestions on alternate EEE parts in order to reduce pricing. Toured GD facilities.
- Working with Hammers Company to address Software Development Plans

7.0 WBS 2.2.2.1 GN&C Systems

Attitude Control Subsystem

- Supported SRR with requirements definition and presentation
- Continued pointing and knowledge error budget development
- Completed draft Coordinate Systems document with Mechanical
- Developed Matlab-based ACS propellant usage calculations to assess impact of thruster locations
- Drafted the Sun Sensor Specification and SOW
- Developed detailed Phase B ACS schedule
- Updated ACS simulation equations of motion to include propellant slosh
- Developed a SimMechanics Probe model for Simulink model validation
- Provided Information on Large Propellant Tank Option

REACTION CONTROL SUBSYSTEM

- Completed technical evaluation of Propellant Tank Vendor Proposals
  - Requested Clarifications as Necessary
- Convened Propellant Tank Source Selection Committee
  - Scored Vendor Selection Against Evaluation Criteria
  - Recommendation Presented to Senior Management
- Hosted EADS for overview of capabilities and discussion of propulsion system design and integration.
- Prepared Review Copy of the Propulsion System Specification
- Prepared Review Copy of the Propulsion System Statement of Work

8.0 WBS 2.2.2.2 S/C ELECTRICAL AND AVIONICS SYSTEMS

- Supported SRR at UCB Berkeley
- Released preliminary versions of the Flight Computer and Bus Avionics Unit specifications for comments
- Visited General Dynamics in Scottsdale, AZ. Discussed Flight Computer implementation, EEE parts program, toured fabrication facilities. Received "Not-to-exceed" price quote
  - Have settled on preliminary parts list for the Flight Computer board, including Bulk Memory devices
- Presented preliminary C&DH design to THEMIS Team and UCB Berkeley in support of developing Probe Bus to Instrument Electrical ICD
- Completed preliminary S-Band Transponder specification
- Completed preliminary Solar Array Laydown specification

9.0 WBS 2.2.2.2.3 FLIGHT SOFTWARE

- Supported SRR at UCB, presented high level Flight Software Requirements
- Ongoing staff meeting support (Supported weekly project status meetings at Swales)
- Supported Swales C&DH engineers with various FSW/HW issues
- Provided additional FSW input to Swales for preliminary spec of GDI Coldfire SBC.
- Supported teleconference meetings with UC Berkeley for microprocessor trade study and other C&DH issues.
- Continued development of Software Development Plan (75% complete) and Software Requirements for the THEMIS project.
- EDT Serial Card Solution (SCAT replacement) successfully tested at Swales.
- Received and configured M5307C3 Coldfire Evaluation board.
- Recompiled selected FAST 8085 code to Coldfire 5307.
  - Increased code sizes observed
- Bootcode successfully loaded and executed on Coldfire Evaluation board using GSFC-provided baseline. (Final Boot PROM Sizing in progress-Evaluation of 8KB size for CPU init, config, EEPROM/RAM copy, code load and application initialization).
- Analyzed EEPROM and RAM estimates required for FSW on Coldfire processor (includes tasks from both FAST processors, EO-1)

10.0 WBS 2.2.2.3 MECHANICAL SYSTEMS

- Supported SRR
  - Attended mechanical splinter meeting with UCB
- Produced and iterated draft mechanical subsystem schedule
- Reviewed antenna procurement specification and provided mechanical comments
- Reviewed BAU procurement specification and provided mechanical comments
- Completed comprehensive Phase B Probe mass estimate update
  - Agreed on mass tracking process and baselined spreadsheet
- Performed updated structural FEA analysis
- Provided list of required interface information to systems team
- Started development panel design
- Issued draft coordinate system document
- Supported propulsion tank selection
- Supported RCS spec development
- Evaluated preliminary propulsion tank packaging in Probe
- Received and evaluated the following from UCB
  - New SST Design
  - Updated EFI-Radial design
- Organized and conducted mechanical telecon with UCB
- Generated preliminary solar array ICD for vendor comments
- Generated preliminary Axial Boom ICD
- Met with Saab on separation systems
- Obtained and distributed background information on Swales SHELS clamp band
- Produced and distributed separation analysis plan
  - Held series of meetings on dynamic separation analysis
- Met with MSC / ADAMS representative to update Swales toolset for THEMIS analysis
- Updated separation system trade matrix
- Finalized Probe Carrier layout trade
- Created initial baseline Probe Carrier design model and placed in Intralink
- Circulated draft of separation system specification

11.0 WBS 2.2.2.4 THERMAL

- Supported SRR at UCB
- Responded to RFA #25
- Reviewed and responded to RCS procurement spec.
- Created, with systems team, 1st draft of Instrument thermal ICDs.
- Gathered mechanical drawings of SC Bus for detailed thermal model.
- Gathered mechanical drawings of SST and EFI drawings for thermal model.
- Discussed battery radiator mounting options with Mech. Team
- Gathered information on RCS Tank mounting interface.
- Started Geometric Math Model in Thermal Desktop Software.
- Started Thermal Math Model in SINDA/FLUINT Software.

12.0 WBS 2.2.2.5 PROBE BUS I&T

- No activity in this area.

13.0 WBS 2.2.4 PROBE CARRIER

- Documented combined launch vehicle 3rd stage and spacecraft energy dissipation time constant assessment

14.0 WBS 2.2.5 MISSION INTEGRATION & TEST

- No activity in this area

II. ANALYSIS OF WORKED PERFORMED

1.0 WBS 2.2.1.1 PROJECT MANAGEMENT

- Awaiting final Terms and Conditions for contract.
- Need to begin discussions with UCB on full contract (Phase B/C/D). The long lead procurements may be impacted relative to cost and schedule if new requirements are imposed by NASA that are significantly different than the Draft Contract Terms and Conditions.

1.1 SIGNIFICANT PERSONNEL CHANGES

- Assigned Kerri Hylan (engineer), Danny Hawkins (designer), and Shelly Conkey (stress) to Probe Carrier
- Purshina Patel has replaced Bruce Reynolds as the planner and financial lead.

1.2 CHANGES OR SCHEDULE/COST IMPACTS

- UCB has provided direction to Swales to proceed with the finalization of requirements and pricing for the General Dynamics ColdFire Single Board Computer (SBC). Swales received revised pricing from General Dynamics on the single board computer which included bulk memory. This pricing was evaluated by Swales and is driven predominately by parts costs. Swales believes that the pricing is competitive and represents best value to the THEMIS program, considering the buy down of long-term risk. Swales and GD are continuing to iterate the parts list to reduce costs; however we are reaching the point of diminishing returns. Swales will begin defining contract terms and conditions for 7 SBCs (5 flight, 1 spare, and 1 EDU) in mid August. Following completion of negotiations, Swales will advise UCB of the cost impact. A contract modification will eventually be required to cover the costs (CFE replacement) associated with this change.
- Procurement planning continues. We anticipate finalization of the Tank contract by mid August and a start date of NLT September 1st. RFPs for the Reaction Control System are expected to be issued by August 15th. The Probe separation system and the transponder will be the next critical procurements to be initiated.
- UCB has tentatively scheduled November 4th and 5th as the Mission PDR dates. The Probe PDR is planned for October 22nd and 23rd.
- UCB has requested that Swales place sixty days (3 months) schedule contingency as one continuous time period prior to Probe Carrier Assembly

integration with the launch vehicle. Swales is evaluating the consolidation of schedule contingency and will address this request in early August.

- Assuming that the Tank and RCS procurements are finalized prior to PDR the pacing hardware will be the Probe 1 flight base panel. The Probe 1 flight base panel is needed for the RCS integration. However the Probe 1 flight structure must be tested with mass models prior to interring the integration flow. This will delay RCS integration due to the amount of time required to procure, fabricate, and test the Probe 1 structure. To elevate this schedule conflict base plate templates will be built to allow the start of the RCS integration.

2.0 WBS 2.2.1.2 SYSTEMS ENGINEERING

- Bottom deck upper temperature limit prediction of +45 deg C is an issue with internally mounted instrument components; they desire a lower temperature which could drive eclipse heater power. Latest recommended temperature range of –20C to +40C awaiting UCB approval.
- Awaiting approval of Tank volume increase System Engineering Change Notice by UCB.
- Swales has recommended to UCB that GSFC be requested to provide an independent radiation environment assessment to verify earlier work performed by UCB. We also have requested that UCB document and redistribute Phase A radiation analysis "for the record".

3.0 WBS 2.2.1.3 LAUNCH VEHICLE INTERFACE

- Kickoff telephone conference with KSC is scheduled for early August.

4.0 WBS 2.2.1.4 LOGISTICS & PLANNING

- No issues at this time

5.0 WBS 2.2.1.5 DESIGN REVIEW

- No issues at this time

6.0 WBS 2.2.1.6 QUALITY ASSURANCE

- No issues at this time

7.0 WBS 2.2.2.1 GN&C SYSTEMS

- No issues at this time

8.0 WBS 2.2.2.2 S/C ELECTRICAL AND AVIONICS SYSTEMS

- The Electrical subsystem received five SRR RFAs. All of the actions represent minor issues with the baselined system architecture.
- GD Flight Computer development feasibility was deemed adequate to move forward with formal RFP
- The C&DH design discussion prompted vigorous debate in the areas of data flow and transfer protocol. Several issues were handled in real time during the meeting while

the actual interface definition details remain unresolved. Follow-up meetings are planned with closure expected by mid-August

9.0 WBS 2.2.2.2.3 FLIGHT SOFTWARE

- Flight Software Requirements from Swales need to be finalized, in order to proceed with FSW requirements document and to establish THEMIS-specific memory size estimates.

10.0 WBS 2.2.2.3 MECHANICAL SYSTEMS

- Preliminary approach is for ACS group to perform separation analysis using ADAMS
  - Mechanical group to concur and provide validation support
- Required Probe antenna changes judged unfeasible therefore baseline Probe Carrier approach will be retained

11.0 WBS 2.2.2.4 THERMAL

- UCB cannot deliver Instrument thermal models by 8/15/03. S/C thermal engineer will have to use one node models and make assumptions regarding the instrument thermal analysis.

12.0 WBS 2.2.2.5 PROBE BUS I&T

- No issues at this time

13.0 WBS 2.2.4 PROBE CARRIER

- No issues at this time

14.0 WBS 2.2.5 MISSION INTEGRATION & TEST

- No issues at this time

III. PLANNED WORK

1.0 WBS 2.2.1.1 PROJECT MANAGEMENT

- Initiate contract discussions with ARDE and issue letter contract when agreement has been reached on technical requirements, schedule, and cost objectives.
- Issue RFPs for RCS.
- Begin contract discussions with General Dynamics on SBC
- Further develop PDR and Procurement schedules
- Develop Draft Risk Management Plan for Probes and Probe Carrier.
- Continue development of Program CM Plan
- Develop a draft of the QA implementation plan with QA
- Complete review of subsystem schedules and incorporate into Welcom Home Open Plan

2.0 WBS 2.2.1.2 SYSTEMS ENGINEERING

- Review changes in the MRD, finalize and review all traceability between requirements, and begin to fill in Verification columns of spreadsheet.
- Continue supporting ongoing trade studies including microprocessor, RF link, and separation system.
- Continue work on draft ICDs
- Continue work on SEMP
- Continue work on System Safety Program Plan
- Continue Tailoring of EWR 127-1, Direct Completion of Tailoring Forms
- Begin review of I & T flow and identifying GSE deliverables
- Begin Development of Safety Compliance Checklist
- Assist in Draft of Program Introduction

3.0 WBS 2.2.1.3 LAUNCH VEHICLE INTERFACE

- Begin Biweekly Dialogs with KSC Mission Integration Manager

4.0 WBS 2.2.1.4 LOGISTICS & PLANNING

- Following SRR, hold a series of meetings with Subsystem leads and develop detail schedules for each subsystem through CDR.

5.0 WBS 2.2.1.5 DESIGN REVIEW

- No activity Plan

6.0 WBS 2.2.1.6 QUALITY ASSURANCE

- Meet with Swales Quality Assurance Manager and outline Swales Quality Assurance Implementation plan

7.0 WBS 2.2.2.1 GN&C SYSTEMS

ATTITUDE CONTROL SUBSYSTEM

- Support requirements refinement
- Continue to develop ACS error budgets
- Draft ACS Performance Specification
- Draft Rate Gyro Specification and PORefine ACS propellant usage calculations to include realistic slewsRefine analysis of attitude determination and attitude control designDevelop thruster fault detection designDraft Simulation and Mission Software Algorithm Description Documents

REACTION CONTROL SUBSYSTEM

- Finalize Propellant Tank Supplier Selection
- Finalize Propellant Tank Mounting and Volume Requirements
- Begin Initial Design Effort on RCS Propellant Tank
- Finalize RCS Preliminary Design Details
- Release Reaction Control System Specification
- Release Reaction Control System Statement of Work
- Complete RCS Bid Package and Distribute

8.0 WBS 2.2.2.2 S/C ELECTRICAL AND AVIONICS SYSTEMS

- Continue to develop Electrical subsystem requirements
- Continue to work the C&DH implementation issues
- Continue to work towards preliminary release of the Probe Bus to Instrument Electrical ICD
- Finalize Flight Processor board requirements and initiate procurement
- Finalize Work Packages and schedule
- Iterate Probe Bus Power performance (BAU cards)
- Finalize Transponder and Solar Array Laydown specifications
- Develop Electrical subsystem Preliminary Designs
- Develop Flight Software requirements
- Develop Battery Procurement Specification

9.0 WBS 2.2.2.2.3 FLIGHT SOFTWARE

- Complete Software Configuration Management Plan Draft
- Complete Software Development Plan Draft
- Flight Software Requirements Specification Draft (Contingent on finalizing of C&DH FSW requirements).
- Continue support of weekly project status meetings at Swales.
- Continue support of the THEMIS issue tracking system on Hammers website.
- Continue support for the ITOS planning: meet with the Swales I&T support staff, discuss ITOS and data rate planning with Manfred Bester at UCB. Test of the replacement front-end system for ITOS will be completed. Should plan to finalize the discussions regarding CCSDS versions, protocols, etc. between UCB and Swales.
- Develop the FSW development schedule and planning to acquire ITOS/VirtualSat equipment.

10.0 WBS 2.2.2.3 MECHANICAL SYSTEMS

- Finalize mechanical environments and verification sections
- Continue to collect interface information
- Continue with structure preliminary design
    - Refine tank mounting design
- Complete development panel design
- Evaluate Solar Array sizing
- Finalize separation system specification
- Produce separation system SOW
- Support the start of separation analysis

11.0 WBS 2.2.2.4 THERMAL

- Complete spacecraft geometric math model.
- Complete spacecraft thermal math model.
- Integrate instrument thermal models.
- Determine orbital worst case environments and run thermal models.
- Perform thermal trade studies using parametric SINDA runs.
- Create thermal plots and organize thermal analysis data.
- Finish preliminary inputs to instrument thermal ICD.

12.0 WBS 2.2.2.5 PROBE BUS I&T

- No activity planed in this area.

13.0 WBS 2.2.4 PROBE CARRIER

- Perform detailed probe/probe carrier separation analysis

14.0 WBS 2.2.5 MISSION INTEGRATION & TEST

- No activity planed in this area.

Enclosure 1 Current Mass and Power Allocations (No Change from CSR)
Note update in process and will be forward to UCB when completed.

Enclosure 2a Preliminary Design and Procurement Schedule (Status August 11, 2003)

Enclosure 2b Master Schedule (Summary Level August 11, 2003)

Enclosure 3 Draft Risk Management Report

Note 533Ms supplied under separate cover

cc:
T. Ajluni with Enclosures 1-3
C. Lashley “
M. Cully “
R. Kraueter “
M. McCullough “
R. Zara “
R. Leboeuf “
JM. Haas “
S. Hammers “