



OREGON STATE UNIVERSITY
HIGH ALTITUDE LIQUID ENGINE (HALE) TEAM

Avionics System Project Closeout

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CONTENTS

1	Overview	1
2	Project Approach	1
3	Project Timeline	2
4	Lessons Learned	4

1 OVERVIEW

The HALE Avionics Systems is a collection of modules that will control and enable ground communication for the HALE rocket that will be launched by OSU AIAA. The HALE rocket will compete in the Base 11 Space Challenge, a contest for student-led teams with a goal of being the first team to launch a liquid fueled rocket into space. This contest presents a number of challenging firsts for AIAA including: the highest apogee for any AIAA rocket, and the first liquid fueled AIAA rocket.

As part of the requirements for the Base 11 competition, the rocket must be constantly transmitting data including it's GPS location to a ground station capable of receiving and reading the data. This need for long range communication is the driving factor behind the research and design of the avionics system that was done for this project. Additionally, to verify the proper and safe operation of the liquid fuel engine the HALE team built a test stand to use for small scale tests of the full scale equipment. This testing environment and the safe remote operation and monitoring of the propulsion system is the reason behind the Test Stand system data acquisition, monitoring and remote system operation program developed by Karsen Burson.

2 PROJECT APPROACH

The initial project focused on the creation of the avionics system needed for the flight vehicle. This approach had a large scale with many tasks that require further research and analysis. Additionally, the development of the control system for the test stand was at a halt. There was a strong need for continued development of the controls which lays the foundation for the flight-vehicle controls. The scope of the project was quickly re-evaluated. The team each had a critical component for the overall system to research and design. This ensures the next team and build and implement the results from this capstone. This approach to the project allowed a reasonable scope to be obtained while still furthering the HALE project.

With this approach, the research and design phase was prolonged. By Spring term, the team was prototyping or simulating the designs to prove validity. This also allowed for revision and updates to be completed. The team also focused on documentation of the designs to ensure the decisions and reasons why are passed on to future teams.

3 PROJECT TIMELINE

- October 8th • CONCEPT PHASE Begin
- October 15th • Engineering Requirements Draft completed
- October 22nd • Project Partner Update
- October 22nd • Risk Register Developed
- October 22rd • Initial System Block Diagram draft developed
- November 12th • Project Charter Developed
- November 12th • Project Partner Update
- December 3rd • Individual Research Implementation Reports drafted
- December 3rd • Project Partner Update
- December 3rd • Initial Power Supply Prototype completed
- December 6th • CONCEPT PHASE END
- December 6th • DEVELOPMENT PHASE BEGIN
- December 6th • Power Supply Prototype Initial Testing Completed
- December 7th • 1st Block Validation or Technical Demonstration(practice)
- December 29th • Karsen: Updated to LabVIEW to work with python
- January 1st • Karsen: Updated software to match sensors on test stand
- January 5th • DEVELOPMENT PHASE END
- January 5th • IMPLEMENTATION PHASE BEGIN
- January 9th • Karsen: System Cold-Flow Test with Propulsion Team
- January 10th • Gabriel: Ground/Flight Vehicle transceiver design complete
- January 14th • Project Database update
- January 20th • Anthony: RF Transceiver Microcontroller chosen
- January 20th • Karsen: Scope Change officially to Test Stand Controls
- January 21st • 1st set of Block Validations
- January 21st • Karsen: Test Stand Sytem Notification Implementation Testing
- January 23rd • Karsen: Test Stand System Test with Propulsion Team
- January 28th • Research Implementation Peer Review
- January 30th • Karsen: Test Stand System Cold-Flow Test with Propulsion Team
- January 30th • 1st set of Block Check Offs

- January 30th • Second Power Supply Design completed
- February 3rd • Avionics Programs Redesign
- February 11th • 2nd Set of Block Validations
- February 20th • Second Power Supply Fabrication and Initial Testing Completed
- February 21st • 2nd Set of Block Checkoffs
- February 27th • Karsen: Test Stand System Cold-Flow Test with Propulsion Team
- February 28th • 3rd Set of Block Validations
- March 6th • Karsen: Test Stand System Bedrock Test with Propulsion Team
- March 7th • Karsen: Bedrock revisions and new implementations
- March 13th • Karsen: Test Stand System Bedrock Test with Propulsion Team
- March 14th • 3rd Set of Block Checkoffs
- March 20th • Karsen: Test Stand System Cryo-Cold Flow Test with Propulsion Team
- March 25th • Antenna and Link Budget and Bandwidth Research Complete
- March 27th • Karsen: Test Stand System Cryo-Cold Flow Test with Propulsion Team
- April 3rd • Power Supply Design Revisions Completed
- April 3rd • Karsen: Test Stand System Cryo-Cold Flow Test with Propulsion Team
- April 6th • Karsen: Test Stand System Code Implementation Testing with Propulsion Team
- April 12th • Karsen: Test Stand System Cold Flow Test with Propulsion Team
- April 13th • Karsen: Test Stand System Hot Fire Test with Propulsion Team
- April 8th • Project Reassessment; Project returned to DEVELOPMENT PHASE
- April 22nd • Initial System Testing
- April 26th • Anthony: Final Avionics Program design completed
- April 27th • Karsen: Test Stand System End to End Test with Propulsion Team
- April 28th • Karsen: Test Stand System Hot Fire Test with Propulsion Team
- April 30th • Cooper: Power Supply Prototypes Completed
- May 5th • Gaberiel and Cooper: PCB Subsystem assembly complete
- May 10th • Anthony: Avionics Program development plan finalized
- May 15th • DEVELOPMENT PHASE COMPLETE
- May 15th • CLOSEOUT PHASE BEGIN
- May 18th • Final System Checkoff
- May 20th • Project Closeout
- May 20th • CLOSEOUT PHASE Complete
- May 24th • Delivery to Project Partner

4 LESSONS LEARNED

Prior to getting too involved with a project, verify the project scope is attainable in the given time frame for the project. Our project scope changed several times during the project as we did more research and began to understand the level of complexity of the requirements to make things function properly. Having to readjust the project scope affected work done in some areas. Thus, the key lesson is to get the most concrete project scope that is attainable as soon as possible in the project timeline to ensure that the project has the highest possible odds of success.

There are also many other lessons we learned which apply to the design recommendations written in the Project Closeout. Overall this project introduces you to new ways to apply the skills learned in school. It also introduced knowledge into aerospace engineering. This is a large scale project, and one that is growing in industry. This meant it was difficult to find information at times. It truly requires effort but it can be extremely rewarding depending on what you put into it.