

# Rapid Aerial Small Methane Leak Survey (RASMLS), 2<sup>nd</sup> Quarterly Report, Public Version

March 31, 2016

**Date of Report:** 2nd Quarterly Report-March 31, 2016

**Contract Number:** DTPH5615T00016

**Prepared for:** DOT, PHMSA

**Project Title:** Rapid Aerial Small Methane Leak Survey

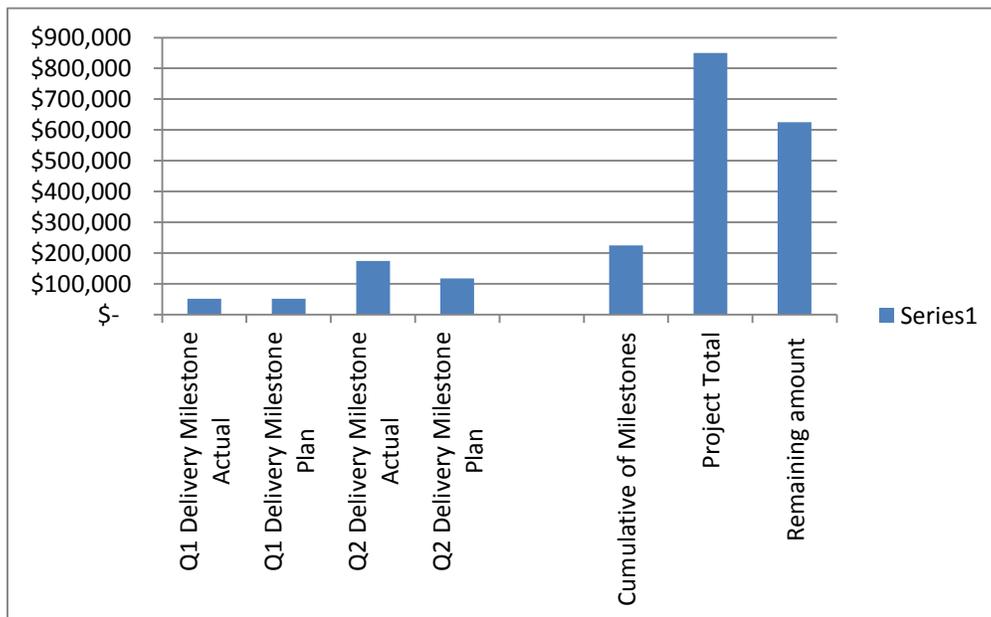
**Prepared by:** Ball Aerospace & Technologies Corp.

**Contact Information:** Phil Lyman, [plyman@ball.com](mailto:plyman@ball.com) 303.939.6869 & Jarett Bartholomew, [jbarthol@ball.com](mailto:jbarthol@ball.com) 303.939.5951

**For quarterly period ending:** March 31, 2016

## 1.0 Funds and Work Completed During this Quarterly Period:

The second quarter of the Rapid Aerial Small Methane Leak Survey (RASMLS) project focused on repeating the “Early Flight Demonstration” (Task 2) which has still not been finished and will slip into Q3. However, data from the first flight in December of 2015 has allowed us to start to Integrate the Complete RASMLS Instrument” per Task 3. **Figure 1-1** shows the value of milestones achieved vs. the value of the milestones planned through the second quarter.



**Figure 1, In Q2, the RASMLS project missed milestone D4 (Early flight test and data collection). It should be completed next month (April, 20126). Milestone D6 (Start RASMLS-specific instrument prototyping) has been achieved ahead of schedule as described in subsequently.**

## 1.1 Technical Status and Progress

**Delivery Milestone D3, Task T0, Technical and Project Management:** This task consists of a level-of-effort for project system engineering, project management and business administration.

**Delivery Milestone D4, Task T2, Early Flight Test and Data Collection:** This activity and milestone had not been planned until Q2 of the project. However, the project team had an opportunity to start this work early. A first flight was performed in mid-December (the last month of Q1). A second flight had been planned for Q2 – in the February-March of 2016 time frame. Extensive data analysis and instrument upgrades have been in work throughout Q2. However, we did not get to a re-flight. There are two technical objectives of the Early Flight Test for RASMLS:

- First, the data and instrument performance are intended to guide the design of the “next-generation” RASMLS instrument. This objective has already been well met. The issues and “lessons-learned” that will be applied to RASMLS are summarized in Table 1.
- Second, the gas concentration data and local meteorological data such as wind speed, are to be used for path-finding the leak rate quantification algorithms. Data from the first flight proved insufficient to support development of these algorithms.

The technical issues, and their resolution, all feed directly into the RASMLS instrument solution for broad area mapping.

Re-flight of the narrow-swath methane DIAL sensor is now scheduled for April, 2016. The first week of April will be used to finalize software and conduct lab testing. The second week will be used for field-testing wherein the instrument will make observations laterally from a mobile lab facility (the laser trailer). Re-flight is scheduled for the 3<sup>rd</sup> week in April.

Specialized equipment to support leak rate quantification algorithm development has been procured to improve the results of the second flight test. The equipment will be used to provide “ground truth” data.

- Better quality flow meters to allow quantification of the leak rate across a wide range of test values.
- A weather station to record wind speed and direction, atmospheric pressure and temperature at the site of the simulated leaks.
- A theatrical smoke generator to allow visualization of plume dynamics in conjunction with the release of invisible methane.
- Video camera to capture smoke plume imagery from a high vantage point during the simulated release.

**Delivery Milestone D6, Task T3, RASMLS-Specific Instrument Prototyping:** This activity and milestone had not been planned until Q3 of the project.

*Design progress:* The optical and mechanical design work is complete. Laser and detector characteristics have been established and confirmed as being achievable with the planned component suppliers. Preliminary design work for the software changes, especially for the field programmable gate array (FPGA) has been completed.

*Component status:* The procurement process for the laser assembly has begun. Laser requirements for pulse rate, pulse energy, average power, line width and tuning of the center wavelength have all been coordinated with the laser supplier. Cost and schedule quotations have been received and we are poised to initiate this procurement.

A higher-performance (lower noise) pre-amplifier is needed for the RASMLS Transceiver Module Detector. A commercially available pre-amplifier has been procured and modified/customized at Ball Aerospace.

RASMLA relies on the Large Aperture, Wide Angle Steering Mirror (LA-WASM) to sweep the laser and observing telescope across track. RASMLS requires a larger scan angle and, therefore, a faster scan pattern. There is some concern that this could overheat either the control electronics or the magnet coils. Additional analysis and testing is needed in the next quarter to resolve this issue. In the limit, additional cooling may need to be added to ensure there are not problems.

## **2.0 Business Status –**

### **2.1 Budget Analysis: Budgeted, Actual and Cumulative Expenditures**

Project cost from inception to date (through March 26, 2015) are \$315,640. This is substantially higher than is being billed through the second Quarter, which is \$224,836.

Task 2, Early Flight Testing (Delivery Milestone D4) is >%80 complete, as evidenced by the progress reported in Section 1.1, we should include the earned value for that activity which is 90% of 89,282 which equals \$80,354. When this is included, the earned value against the project plan is  $\$80,354 + \$224,836 = \$305,190$ . This accounts for the lag in our billing. However, it does not provide a sense of the “earned value” – or whether the remaining work fits within the budget.

Ball Aerospace performs quarterly reforecasting and re-assesses the estimate to complete (ETC) and estimate at completion (EAC) on all projects. This reforecasting takes into account issues that have been encountered and any changes in the design, test and procurement planning. Figure 2 presents the conclusion of the most recent quarterly reforecast, from March 1, 2016, and shows:

- A) We have spent more than we planned (green line above pink line)
- B) But we are still projecting we will conclude the project within budget

### **3.0 Schedule**

The project Pert chart and schedule is show in **Figure 3** (next page). Task 2 is >90% complete as of the end of Q2, making this task slightly behind schedule. Task T3 has started and is ~20% complete, which puts this work slightly ahead of schedule.

### **4.0 Payable Milestones**

As described in Sections 1 and 1.1, above, payment Delivery Milestones D3 and D6 have been achieved and should be invoiced this quarter. The invoice amount should match the payment plan from the Agreement, Attachment 5. Although Task 2 is 90% complete, we are not quite ready to invoice for payment Delivery Milestone D4.

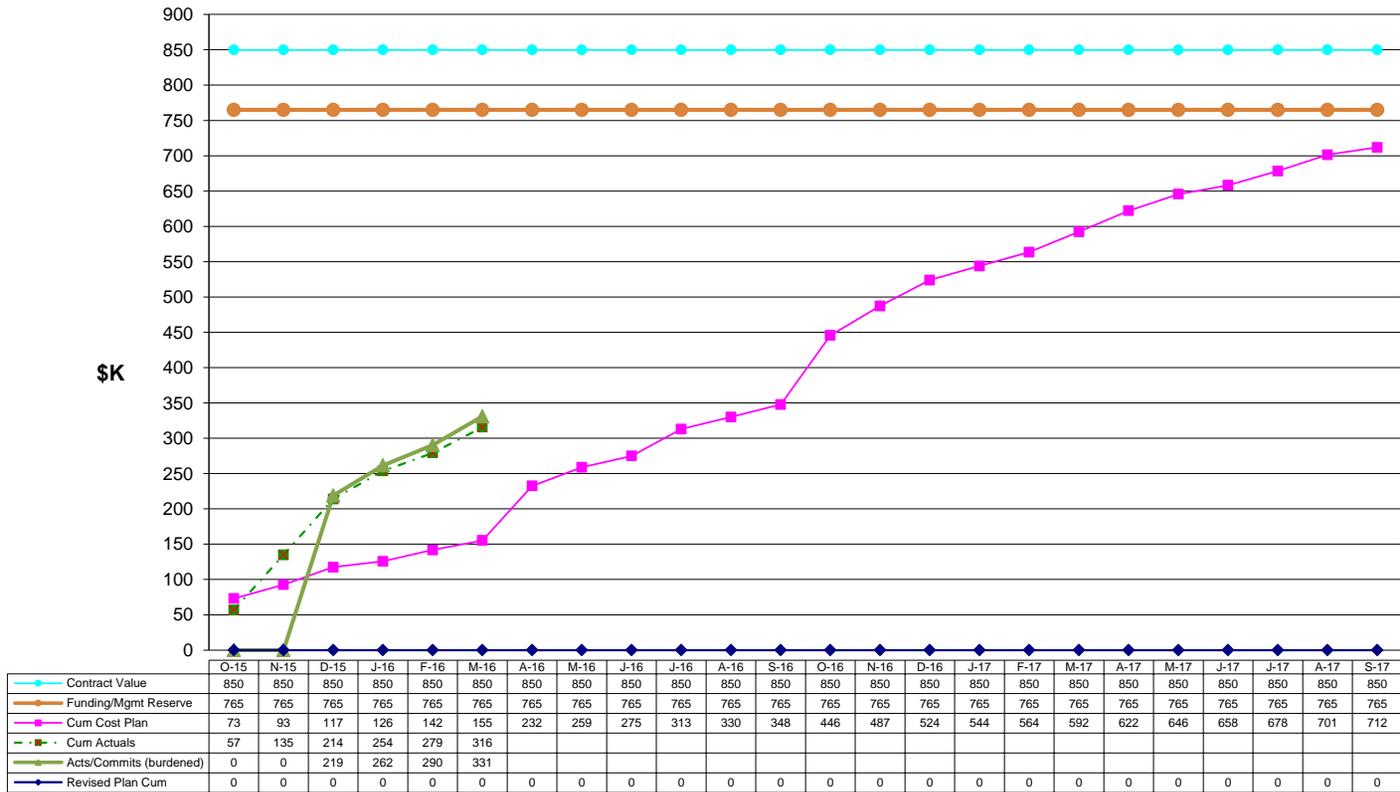
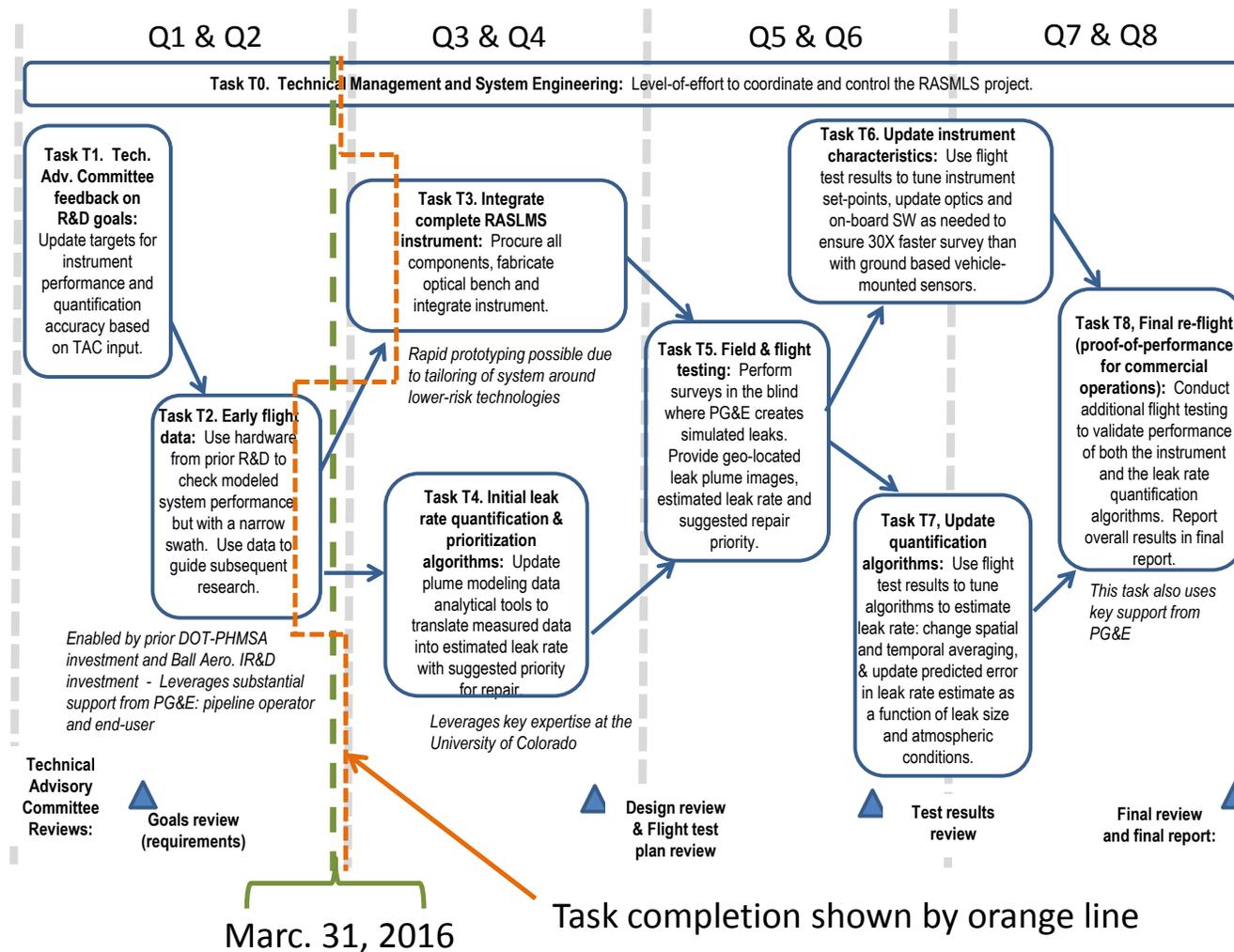


Figure 2, Project actual costs vs plan (as of March 1, 2016)



**Figure 3, RASMLS project is on schedule. Task T2 is slightly behind schedule and >90% complete and Task T3 is 20% complete and slightly ahead of schedule.**

