Sounding Rocket Working Group

National Aeronautics and Space Administration

Meeting of June 7-8, 2016

Findings

1. Congratulations to Orbital Sciences Corporation for NSROC III contract

Summary

The Sounding Rocket Working Group (SRWG) congratulates the Orbital Sciences Corporation (OSC) for the NASA Sounding Rocket Operations Contract-III (NSROC-III). We look forward to working with the OSC team and wish them every success as they continue to enable important scientific research using innovative, highly successful sounding rocket missions. A few concerns regarding the new contract are noted.

Background

The Sounding Rocket Working Group (SRWG) extends its congratulations to the Orbital Sciences Corporation for their selection as the prime contractor for the NASA Sounding Rocket Operations Contract-III (NSROC-III). We look forward to working with the OSC team and wish them every success as they continue to enable important scientific research using innovative, highly successful sounding rocket missions.

The SRWG has noted some concerns with the new contractual arrangement as presented at the SRWG meeting. Three initial remarks of the working group are as follows:

(1) The SRWG believes that it is important to maintain the incentives to ensure that NSROC makes every effort to meet comprehensive success for every rocket, in addition to minimum success. It is unclear if a mechanism is present in the contract to ensure that NSROC is fully engaged to ensure that this critical aspect of the program is achieved.

(2) We learned that OSC intends to interact more with the PI teams in order to "help" them. Although on the surface this sounds quite beneficial to all, this prospect has nevertheless raised a few eyebrows within the science teams. We look forward to learning more about this proposed process and its benefits.

(3) We re-state our concern that a 5-year contract is too short for NSROC, as the process for the follow-on contract will need to start in 3+ years, tying up people and resources. With respect to the program, given that sounding rocket missions are designed/built/tested/launched in a span of 3-4 years, the brief tenure of the project almost guarantees that many missions will be need to straddle between contracts, as has happened before with detrimental effects. We continue to recommend that the NSROC contract be a 10-year contract (or a 5 year + 5 year renewal), as was the case with NSROC-I.

2. Flight Termination System Development

Summary

A new Flight Termination System (FTS) is under development that promises to accommodate a wider range of motors beyond the current Black Brant IX system. Although the SRWG encourages this innovation, we are very troubled by the current plan which would cease production of the current system before the new system is fully operational. Furthermore, if the new system is delayed, it would be "back-stopped" with a forward end-cap mounted shaped-charge system that could destroy the scientific payload if activated. The SRWG strongly recommends that the current FTS system be maintained in full production until the new system is both fully qualified and joins in a simultaneous, full production status.

Background

Flight Termination Systems (FTS) have long been in use in the sounding rocket program and, in fact, are required at the White Sands Missile Range (WSMR). Starting in 2009, a legacy paddle system used by the sounding rocket program was no longer allowed by WSMR range safety. The program then went through a protracted and difficult period of technology development of a replacement system that now appears to be in stable operation. We have only recently recovered from this extended period of uncertainty and constrained supply of FTS systems for use at WSMR. Indeed, the replacement program was significantly delayed by technical, supply, and production hurdles that went through a very limited number of "Hybrid I" and "Hybrid II" FTS systems that were given only limited approval by WSMR range safety. In the end, flights were constrained at WSMR due to the unavailability of FTS systems. As a stopgap measure, NSROC deployed a system developed by Orbital for the Pegasus launch vehicle which is a shaped-charge system mounted on the forward end-cap of the Black Brant motor. In the legacy paddle system, and its replacement (the FTS system currently in use), detonation of the FTS allows the scientific payload to be fully recovered as long as the vehicle is high enough to arm the recovery system. In contrast, the Orbital/Pegasus FTS would immediately destroy the payload whether or not the recovery system was armed.

The SRWG has learned that a new Flight Termination System (FTS) is now under development that promises to accommodate a wider range of motors beyond the current Black Brant IX system. It is our understanding that the current development plan for a multi-vehicle FTS is to cease production of the current FTS design, relying on existing inventory to carry the program through the qualification and production start-up of the new design. If there are delays, the plan is to "backstop" again with shaped charges on the forward motor cap, which would destroy the scientific payload if the termination system is activated. This is, essentially, the same awkward (and potentially disastrous) plan used for the last FTS development, described above. The SRWG strongly recommends that the sounding rocket program develop an over-lapping production plan for the current FTS and any replacement so that there is no potential for a production gap, and, furthermore, that there is no plan to use an FTS that will, if activated, likely destroy the scientific payload.

3. Improving "work on the pad" at WSMR

Summary

Issues regarding work on the pad at the White Sands Missile Range (WSMR) are described including those with long umbilical connections and the need for detailed briefings. Various remedies are recommended by the working group.

Background

The transition from range horizontal to pad operations at WSMR has proven to be disconcerting for various payload teams. The extension of umbilical connections through long landlines increases impedance, inducing, sometimes significant changes in power requirements and payload signal quality. Troubleshooting and understanding the relative importance of such changes with respect to the likelihood of mission success can be time consuming, increasing schedule risk as the pad workforce ramps up. Much of this risk could be mitigated through the implementation of landline emulator testing systems at the VAB that mirror those employed on the pad. The SRWG recommends that the use of such a system be investigated.

The SRWG is also concerned that experimenters and payload subsystem teams are not receiving significantly detailed briefings regarding pad operations and arming procedures prior to and during countdown, particularly in cases where the activities of the arming team and experiment team require close coordination. We recommend a more complete articulation of the "rules of the pad" within the Safety Briefing at the Design Review with subsequent reiteration during the Mission Readiness Review. This should include the Boom and mini-Boom test procedures to be followed for powering up payload systems for the first time on the pad with motors loaded. It should also include the rules for permitted power to various payload systems during the cat-B and cat-A arming phases, especially with regards to internal and external vacuum and cryogenic systems.

4. Optimizing telemetry interfaces with experimenters -- T/M emulators requested

Summary

The SWRG supports NSROC in providing increased functionality in their telemetry systems. Many science teams are also implementing new strategies that provide easier interfacing with NSROC during integration and in the field. We recommend that NSROC provide (i.e., loan) science teams with the necessary hardware (i.e., emulators such as non-flight PCM stacks or "T/M suitcases") to access and monitor the telemetry stream both in the field and at home, in order to streamline the T/M interface, reduce errors, and optimize the interpretation of data "real time", which is often critical for launch decisions.

Background

NSROC continues to provide increased functionality in their telemetry systems, which is strongly supported by the SRWG and user community. In concert with this, science teams

develop their own telemetry interfacing hardware/software to ease integration and field operations. Some teams might purchase a PCM decoder card (Ulyssix Tarsis) as well as a license for Dewesoft software. In many cases, it is preferred that emulators such as non-flight PCM stacks be provided (i.e., loaned) by NSROC directly to the experiment teams. This provides a functional copy of the exact hardware that WFF uses, both in the ground stations during integration as well as during launch operations. Such an arrangement has three major advantages.

First, if the science team is provided with a non-flight PCM stack that is functionally equivalent to the flight unit, then the team can perform end-to-end integration tests of the entire hardware chain at their institution. This is a tremendous improvement. Previously, the first actual hardware-to-hardware handshaking was encountered for the first time at integration at Wallops, which is problematic as subsequent errors delay integration until they are found and fixed. When a science team implements a solution at their home institution, then subtle timing errors and strange edge case behaviors can be identified early and corrected in their own internal "integration" many months before shipping to WFF. At that point, everything is 100% plug-and-play and no time is lost to oversights that would have otherwise been present. This saves travel time, stress, and schedule slips.

Second, science teams can develop a GUI/readout for housekeeping and data in the lab that can then be used in the field. Having a "home setup" allows the science team to have a significant amount of pre-flight training and experience of monitoring their experiment via the Dewesoft GSE. Thus during launch operations, they can be more confident and substantially more prepared to make decisions based on housekeeping for uplinks. Previously, it has been difficult to find time to display analog housekeeping in engineering units on the old GDP boxes. Dewesoft also has powerful functionality to color code readouts to help identify abnormal conditions within the vast amount of TM data. Science teams can tighten and tune the indicators based on real-world performance of the instrument in the lab over a long period of time, permitting an understanding of the subtle behaviors of the experiment well before launch operations.

Third, utilizing the same hardware as NSROC has the advantage of putting the science team in a better position to interface with NSROC regarding any telemetry related issues. For example, the TM engineer can help with GUI issues and the science team in turn has enough knowledge of the NSROC setup to help them if need be. Common terminology and hardware allows the science team to become more involved with integration, which can be frustrating if science teams do not have adequate knowledge or experience to understand the nuances of the TM subsystem if a problem arises. Having a home setup allows for a much more collaborative process where science teams and Wallops telemetry engineers use language and tools that are common among all parties.

To enable these telemetry interface strategies, we urge that TM emulators such as non-flight PCM stacks or TM "suitcases" be provided for experimenters so that science teams have access to the telemetry stream that they will encounter on the payload, both for use in their laboratories and in the field (e.g., the VAB, blockhouse, etc.). This request supports the overall end goal of reducing errors, saving time, easing integration and field preparation, and ultimately ensuring successful launch operations.

5. Continued Support for New Launch Vehicles

Summary

The SRWG commends the concept study of new launch vehicle systems to address the goal of longer duration, high altitude flights. Furthermore, we strongly encourage the continued testing of the remaining Peregrine motors at WFF. Observation times of 650 seconds above 150 km represent an approximate two-fold increase over Terrier-BBIX vehicles. Such high altitude sounding rockets also underscore the value of on-going water recovery efforts by enabling this launch capability at a wide range of latitudes without compromising reusability.

Background

The SRWG commends the concept study of new launch vehicle systems to address the goal of longer duration, high altitude flights. For example, the new "packaging" of existing vehicles (e.g., Terrier-Black Brant combinations) shows great promise and we endorse their continued study. The study results show that up to 650 seconds of time above 150 km for a 1200 lb. payload may be obtainable with new packaging of existing vehicles, including a three-Terrier first-stage cluster. While the goal of the concept study was to investigate plausible combinations to obtain 700 seconds above 150 km, 650 seconds is far enough above the Terrier-BBXII estimate of 475 seconds that it enables significant new science opportunities, particularly for solar and astrophysics telescope payloads. We therefore recommend the continuation of this investigation. We are particularly interested in the logistics of such vehicle packages, such as what sort of launcher would be required, cost feasibility of development, a list of potential launch sites where this capability could practically be implemented, and, if possible, a technical demonstration of a three-Terrier cluster. We also wish to consider what capabilities such vehicles would enable for geospace missions.

In parallel, the SRWG strongly encourages the continued testing of the remaining Peregrine motors at WFF. The Peregrine program has value as a hedge against potential future problems with the Black Brant IX, as well as providing motor development and testing experience. The static burn of one of the remaining two motors, and the potential launch of the last motor, will inform future efforts, and may provide the data necessary to fix the Peregrine design.

6. Scheduling rocket operations at different launch sites

Summary

The SRWG is pleased that the Poker Flat, WSMR and Wallops Island launch sites are considered standard and available for proposed launches every year, and that other launch ranges including remote campaign sites, will continue to be considered. The SRWG recommends an approach whereby the launch locations of Norway, Kwajalein, and Australia -- where Wallops has much experience -- become available on a systematic or regular basis, insofar as possible. The SRWG continues to strongly support "campaign" operations at remote locations for unique scientific investigations, which is a hallmark of NASA's sounding rocket program.

The SRWG further recommends that the schedule chart be posted in a public space or website. This would enable a larger group of investigators to propose for sites other than Poker, WSMR, and Wallops, including remote campaigns, and would minimize the probability that proposals are submitted for remote locations that are not yet approved or deemed feasible.

Background

The SRWG is pleased that the Poker Flat, WSMR, and Wallops Island launch sites are considered standard and available for sounding rocket launches every year.

There are three additional launch locations where Wallops has much experience -- Norway, Kwajalein, and Australia -- and for which there is significant, continued scientific interest to launch sounding rockets. Given the various financial and logistical challenges, the SRWG understands that these locations may not all be available for launches each year. However, we urge that these sites continue to be considered as viable launch locations and that they be made available on a regular, systematic basis, insofar as possible. As such, experimenters could propose and plan accordingly for launches at each location.

Mobile campaigns, such as sounding rocket launches at remote ranges, continue to be a hallmark of the sounding rocket program, enabling unique, important scientific investigations to be carried out in a variety of locations and launch conditions for which the data cannot be obtained by any other means. We continue to urge that such campaigns be supported by the Sounding Rocket Program, as noted in many previous Findings of the SRWG.

Finally, the SRWG suggests that both NASA HQ and Wallops publicize updated plans for launches at Norway, Kwajalein, and Australia, as well as those planned at remote campaign sites, perhaps by placing within the ROSES announcement a link to the Launch Operations charts that Wallops regularly prepares and shares with the SRWG. These plans would be considered tentative and non-binding in keeping with-ROSES AO instructions. The chief goal is to optimize the community awareness and streamline its participation in launch opportunities at all launch sites, as well as to prevent the generation and receipt of sounding rocket proposals at implausible locations.

NASA Sounding Rocket Working Group

Dr. Robert Pfaff, Jr. (Chair and Project Scientist)
NASA/Goddard Space Flight Center

Dr. Scott Porter (Deputy Project Scientist)
NASA/Goddard Space Flight Center

Committee Members:

Dr. James Clemmons
Aerospace Corporation

Dr. Richard Collins
University of Alaska

Dr. Kevin France
University of Colorado, Boulder

Dr. Lindsay Glesener
University of Minnesota

Dr. Craig Kletzing
University of Iowa

Dr. James LaBelle
Dartmouth College

Dr. Stephan McCandliss
Johns Hopkins University

Dr. Randall McEntaffer
University of Iowa

Dr. Marilia Samara
NASA/Goddard Space Flight Center

Dr. Amy Winebarger
NASA/Marshall Space Flight Center