Sounding Rocket Working Group

National Aeronautics and Space Administration

Meeting of January 27-28, 2021

Findings

1. New Civil Servant Mission Manager Paradigm

Summary

At the January 2021 meeting, the Sounding Rocket Working Group (SRWG) learned of proposed changes to the NASA Sounding Rocket Contract (NSROC) that would re-institute civil servant mission managers in the Sounding Rocket Program Office (SRPO) to supervise individual sounding rocket missions. The new arrangement would also separate the NSROC fee from the mission success of each individual rocket, instead making that fee contingent on whether sub-systems worked, and scientific instruments were provided their desired configuration. Both of these changes promise to encourage and ensure scientific innovation as well as make the program more efficient. The stated rationale behind the changes: (1) Direct interface of the SRPO to the PI, (2) SRPO ownership of the risk, and (3) retention of mission expertise within the government, are all endorsed by the SRWG. The chief concern of the SRWG is to ensure that civil servant managers have the authority to manage contractor tasks and fix problems in the field.

Background

Ever since the start of NSROC in 1999, the SRWG has played an important role in helping to evaluate the merits of the new management system including its technical capabilities and cost efficiencies. As outlined in our extensive SRWG Finding from the meetings of December 7, 2000 and June 15, 2001, the SRWG concluded that, in general, NSROC was highly capable and preserved the key aspects of NASA's sounding rocket program which is so vital to NASA's scientific research for carrying out critical space-based observations in the Geospace, Solar, and Astrophysics disciplines.

There were concerns stated at that time with the fact that individual mission success, including the success of the scientific instruments, determined the contract fee which would lead to a more conservative approach with respect to risk as well as higher costs passed on to NASA to ensure mission success. Decoupling fee and mission success would result in more innovation and lower costs. Despite the success of NSROC, there were stories of Principal Investigators compromising success criteria to increase the likelihood of the technical success of the payload and rocket as well as additional funds spent on a given mission to provide abundant margin to ensure that success. To avoid this possible conflict, separating fee and mission success is the preferred arrangement,

with NSROC being rewarded for whether sub-systems, for which they were specifically responsible, worked and whether the scientific instruments, provided by the experimenters, were delivered to space in their desired configuration.

With respect to the management of individual rockets, whereas NSROC mission managers have proved highly capable and dedicated to achieving success, the interface between the NASA-sponsored Principal Investigator and NSROC has not always been straightforward, particularly with the inclusion of the SRPO "Mission Operations Manager" or MOM in the mix. Having the SRPO administer the mission management would provide a direct interface between the means to execute the research, led by the SRPO, and the Principal Investigator, who has been selected and funded by NASA to carry out a specific scientific objective. Reverting to civil servant mission managers, as was carried out during the initial 40 years of NASA's sounding rocket program, provides a clearer path to efficiently carrying out a scientific investigation. Managers reporting directly to the SRPO will have direct decision authority to resolve technical trades and help resolve schedule conflicts. They will also greatly assist decision-making in the field where the agreements between the various rocket ranges and the program office are administered by the NASA program office. This arrangement would also help to ensure that the rocket and payload expertise is kept in house at NASA, ensuring the long-term viability of the program. This is particularly important since the NSROC contract changes every 5 years, despite the continued recommendations by the SRWG and the SRPO that NSROC be a 10-year contract.

From a practical standpoint, the SRWG's chief concern regarding having the mission managers be civil servants involves their authority to manage the tasks to be completed by the engineers and technicians who are part of the NSROC contract, particularly with respect to fixing problems in the field. The new arrangement will require careful development of the mission task orders, requirements, and schedules. As this approach did work well in the past, we are confident that the new NSROC contract will incorporate the necessary provisions to implement a well-working cadre of engineering support and technical expertise that is required to ensure mission success.

2. **Implementing "Ship and Shoot" Procedures**

Summary

The SRWG was briefed on the "Ship and Shoot" concept in which a "ready to fly" payload would be shipped to the field and subsequently launched without extensive field testing. This approach would reduce team travel particularly for remote and foreign deployments, thus reducing range and travel costs. The SRWG encourages that the "ship and shoot" concept be tested, where feasible, as it appears to have many advantages. However, it may not work for every mission. For example, certain scientific payloads may require special treatment during transportation such as maintaining vacuum, cryogenic systems, or dry nitrogen purge that will be unique to every design. Nevertheless, as this approach promises to decrease time in the field and thus stress on the workforce, the SRWG encourages that this option be explored. We further recommend engaging the PI early with the possibility that this method of operation be used in order to encourage "buy in" from all parties.

Background

The SRWG was briefed on the "Ship and Shoot" concept in which a "ready to fly" payload would be shipped to the field and subsequently launched without extensive field testing. This approach would reduce team travel particularly for remote and foreign deployments, thus reducing range and travel costs. At this time, the SRPO is evaluating a number of scenarios, with the first attempt from White Sands later this year, and possibly for the Jones mission from Poker next winter.

Of the various "Ship and Shoot" Scenarios under consideration, the shortest scenario would ship the entire payload, "tip to tail" with all systems tested and the ordnance installed. The payload would be shipped directly to the launch site via aircraft. A second scenario would be similar to the present situation, except sub-systems would not be dissembled for testing in the field. Here, the ordnance would be installed in the field, with traditional sequence testing at the range before the payload is moved to the launcher.

The SRWG acknowledges that "ship and shoot" is innovative and has many advantages. However, it may not work for every mission and thus may not always be a cost saving method. For example, certain scientific payloads may require special treatment during transportation such as maintaining vacuum, cryogenic systems, or dry nitrogen purge that will be unique to every design. However, for many missions, it appears as if this approach will decrease time in the field and thus stress on the workforce. Inevitably, this allows for additional time between the next mission in line. The SRWG encourages that this option be explored, where feasible, and recommends engaging the PI early with the possibility that this method of operation be used as "buy in" from all concerned will enlighten the decision to pursue the ship and shoot method.

Finally, the SRWG would like to recognize the SRPO and NSROC on the innovation demonstrated in developing methods of continuing limited flight operation during the COVID-19 pandemic, rather than shutting down completely. An example is the "ship and shoot" operational method that allows supporting launches from White Sands while keeping the NASA and White Sands teams safe by limiting the potential spread of the virus during transportation of equipment and personnel. The SRWG applauds the thinking outside the box to use the C130 to ship and shoot White Sands missions and encourages exploring the feasibility of this operations approach at other launch ranges as well.

3. The Revitalized Wallops Geophysical Observatory

Summary

The SRWG was pleased to hear the report on plans to revitalize the Wallops Geophysical Observatory (WGO) which provides support for a number of existing and planned ground-based research instruments at Wallops. The existing instruments include ionosondes, the SuperDarn HF radar, a sensitive magnetometer, and a GPS receiver, all of which are independently funded by experiment teams yet require minimal infrastructure support (shelter, electricity, air conditioning, lawn mowing, internet connections) from the Wallops range to operate efficiently. In addition, the SRWG learned of possible enhancements to the SPANDAR radar on Wallops Island, currently used primarily for tropospheric applications, and fully supports on-going studies that will

determine whether SPANDAR could be effectively converted to become a useable ionospheric radar.

Background

The SRWG was pleased to hear the report on plans to revitalize the Wallops Geophysical Observatory (WGO) which provides support for a number of existing and planned ground-based instruments at Wallops. The WGO is also a means for new ground-based scientific instruments to be situated at Wallops, either on a temporary basis to support individual rocket missions or to provide long-term, synoptic measurements. An example are ground-based VLF radio receivers which will be installed at Wallops in support of the upcoming Bonnell mission in 2021.

Such ground-based scientific instrumentation provides essential knowledge concerning the atmosphere and ionosphere in support of flight programs at Wallops, as well as long term baseline measurements in which future missions can be planned and flight data may be placed in context. For some experiments, the ground measurements are an integral part of the interpretation of the data gathered on the sounding rockets.

The existing WGO instruments include two ionosondes, both operated by the University of Colorado, Boulder: a standard, continuously operating digisonde and a Vertical Incidence Pulsed Ionospheric Radar (VIPIR), that was originally installed at Wallops with NASA funds for the Earle rocket mission to study mid-latitude ionospheric irregularities in 2007 and has since been used for a number of follow-on NASA and DoD sounding rocket missions. The WGO also includes the NSF-funded SuperDarn HF radar, a sensitive magnetometer operated by Goddard, and a DoD-supported GPS receiver, all of which are funded by individual experiment teams but require minimal infrastructure support (shelter, electricity, air conditioning, and internet connections) from the range. In particular, the magnetometer currently uses a trailer that requires repair. The SRWG supports the replacement of this trailer but cautions that the magnetometer location was selected due to its quiet location which should be maintained.

Creating a formal means to provide this infrastructure is a welcomed, low-cost investment by Wallops that will ensure that NASA's long-term research goals to explore the Geospace environment are met. Accordingly, we applaud the work of the Wallops Flight Facility in their maintenance and fostering of the Wallops Geophysical Observatory.

In addition to the WGO, other ground-based instruments at Wallops have been supported separately for many years by various atmospheric research entities at the Goddard Space Flight Center (located at Wallops) and which include field mills and lightning detectors, important to verify if it safe to launch rockets and satellites, as well as other atmospheric instruments. One such instrument is the SPANDAR radar which exists on Wallops Island and which has historically been used to support tropospheric research. In addition to the general revitalization of the WGO, the SRWG also learned that possible enhancements to the SPANDAR radar are being considered that would enable higher altitude, ionospheric measurements to be obtained with this instrument. This radar with its powerful MW transmitter, could be converted to an incoherent scatter radar to study the ionosphere, perhaps starting at lower altitudes (< 400 km).

The ability to launch rockets in conjunction with an incoherent scatter radar opens a number of important new research areas involving ionospheric and upper atmospheric research. To have this capability at Wallops would bring immediate international importance to NASA's Wallops Flight Facility as a research center for which numerous coordinated missions using rocket/ground-based instruments are anticipated.

A study to determine whether SPANDAR could be effectively converted to a useable ionospheric radar is underway. The SRWG supports this study and looks forward to learning its conclusions regarding the technical feasibility of the radar, as well as its estimated costs, when available.

4. Need for a Talos replacement

Summary

The SRWG recognizes the importance of the Black Brant XI and XII capabilities, which are dependent on the Talos Mk 11 booster. The existing supply of these motors will be exhausted in approximately five years, and refurbishment of existing surplus is currently backlogged. A development project with the U.S. Navy is being completed that has designed an upgraded replacement for the Talos called Talos II that is now ready to begin fabrication. Although more expensive than the surplus motors, the Talos II appears likely to be the most feasible route to maintaining the program's high-altitude capability which is so important for a wide variety of NASA's scientific research projects across many disciplines. Accordingly, we encourage the Sounding Rocket Program Office to support this development and remain suitably engaged to maintain this option for future high-altitude rockets.

Background:

The Black Brant XI and XII vehicles are central to much of the magnetospheric and auroral research carried out on sounding rockets, with continued promise for astrophysical and solar telescope payloads that provide longer "hang time" and thus longer observing times. Both the Black Brant XI and XII vehicles employ the surplus Talos motor as the first stage. The supply of these motors is limited and is expected to be exhausted in several years. The Navy Target Group is developing an upgraded replacement for the Talos called the Talos II. This has recently passed CDR and is ready for fabrication and testing.

While the Talos motor is expected to be more expensive than the current surplus motor, it is probably the most feasible route to maintaining the program's high-altitude rocket capability, while providing improved performance. We strongly encourage the Sounding Rocket Program Office to follow up on this potential opportunity.

The Talos II motor would also be an enabler for future vehicle developments. Its 30" diameter would facilitate the design of vehicles suitable for 1-meter class astronomical and solar telescope instruments. There is also interest in the Heliophysics Geospace community to take advantage of the longer observing times for instruments that do not need to be recovered, with the greater heights and times for observations outweighing any hardware losses. It would also be an appropriate first stage for the "high-altitude sounding rocket" discussed in several previous SRWG findings.

Relevant to this goal, the Navy project has also developed a second motor, the Castor Ib. Together with the Talos II this could provide a two-stage, high altitude rocket system. The SRWG encourages that cost-benefit tradeoffs for a capability such as this be evaluated and looks forward to the results of these studies at future meetings.

5. Follow on to Cryogenic Safety Training Procedure

Summary

The SRWG acknowledges and commends the SRPO and the Wallops Safety Office in providing flexible arrangements for experimenters to meet the program's cryogenic training requirements. As an important follow-on for both current and new experimenters, the committee requests that the program distribute a clear and accessible guide outlining the pathways toward meeting the requirements for cryogenic certification and to continue offering virtual training to the experiment teams.

Background

The SRWG acknowledges and commends the accommodating response of both the SRPO and the Wallops Safety Office in providing flexible arrangements for experimenters to meet the program's cryogenic training requirements (e.g., allowing for the approval of institutional training and implementing virtual program-led training). In order to reduce confusion amongst current and incoming instrument teams, the committee requests the program distribute a clear and accessible guide outlining the pathways toward meeting the requirements for cryogenic certification. This guide should be included in the experimenter orientation handbook currently under development. In addition, continuation of the availability of virtual instruction into the future is requested as it reduces the travel burden on payload teams while also broadening the accessibility and impact of the training itself.

NASA Sounding Rocket Working Group

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