Sounding Rocket Working Group

National Aeronautics and Space Administration

Meeting of January 20-21, 2016

Findings

1. Ensuring Critical Connections Are Made Correctly

Summary

In light of the recent vehicle failure of rocket 49.003 that resulted from an apparent swap of pyro event connectors and given that there have been several other connector swap incidents of varying consequence, the SRWG believes a review of the current processes with respect to industry best practices of avoiding swapped connectors is warranted. We urge that a low-impact solution be sought to provide increased assurance that vital connections are made correctly.

Background

With the recent vehicle failure of rocket 49.003 that resulted from an apparent swap of pyro event connectors and given that there have been several other connector swap incidents of varying consequence, the SRWG believes a review of the current processes with respect to industry best practices of avoiding swapped connectors is warranted. The consequences of swapped connectors can vary greatly, and often such errors are caught quickly and no harm is done. On the other end of the spectrum, however, the impact to both schedule and budget can be extreme if damage is done to the payload, vehicle, or instrument. It is recognized that industry understands the risks involved with the possibility of connector errors, and standard processes exist to lower the likelihood of such problems.

In industry, generally, the connector attachment processes involve extensive safe-to-mate procedures for all connectors and logging each mate/de-mate operation in a logbook. It is recognized that such actions may be efficacious in high-reliability situations such as are commonly encountered during satellite mission operations, but such a heavy-overhead system may not be tractable for an operation such as the sounding rocket enterprise where low cost and rapid operations are needed. Sounding rocket missions generally see a high number of mate/de-mate cycles, including many in the field during final integration at the launch site, and requiring that cumbersome processes be followed for these operations have the potential to drive cost and schedule. In other words, the SRWG understands that changes in these processes must be weighed against growing the cost of operations. That said, we urge that a low-impact solution be sought to provide increased assurance that vital connections are made correctly. For example, some of the low-impact solutions that could be explored to diminish the possibility of attaching incorrect connectors include:

-- Use unique connector types
-- Use keyed connectors
-- Stagger harness segments strategically
-- Use clear and unique connector numbering and marking for easy, visual confirmation of a correct mate

A small financial increase that greatly reduces or eliminates the possibility of a mistake is well worth the cost. This is particularly the case for vehicle pyro events, for which errors can be very costly. Because vehicle pyro events cannot be directly tested during sequence testing, the final, flight connections to the actual pyros are made post-sequence test, so that an error in the connection at this stage can result in mission failure. These final connections should be unmistakably clear and verifiable via safety, quality control and inspection photos. The SRWG understands that NSROC and the SRPO are already working toward a solution, and we believe that the process would benefit from a review of all connector design, selection, purchasing, usage and mating processes and procedures.

2. Mission Oversight Monitors

Summary

The SRWG is supportive of SRPO's initiative to become more involved in the management of missions. We recommend that the SRPO clarify the role of the proposed Mission Oversight Monitor (MOM) such that it emphasizes advocacy for the PI and their team.

Background

The SRPO has unveiled a new role that it has created to be executed by SRPO members during the new NSROC III contract. This role has been named Mission Oversight Monitor, or MOM for short. The role was created to increase the impact of the SRPO in management decisions and to involve the SRPO in each phase of a mission. This may allow for identification of potential issues and hurdles before they become critical issues that require decisions that must be made in short timeframes.

The SRPO envisions several duties for the MOM. First, the MOM will manage the project from the MIC to the RDM of each mission. This is a critical phase where the MOM will work with the NSROC MM to develop requirements, a mission schedule, and a mission timeline. From the RDM to DR and to MRR, the MOM will attend all meetings in an approval and "oversight" role. The MOM may also travel to the field for launch activities.

The SRWG desires clarification of these roles. First, the name Mission Oversight Monitor seems geared toward policing of a mission as opposed to assisting with the mission. A name that suggests advocacy for the scientists and the mission as a whole would be more appropriate. It was also stated that during the pre-MIC phase, the MOM will be assisting in the transfer of original proposal ideas to a MIC and ultimately requirements. It should be clear that some modifications from the proposal by the PI are allowable and expected, provided that they do not change the science thrust or scope of the mission. The MOM should not serve as a proposal referee but assist the PI in the definition of the MIC and

requirements based on the most recent set of goals at the time of the MIC. The SRWG appreciates that the MOM will assist in minimizing requirement creep between the MIC and RDM.

Finally, the SRWG is concerned about the implementation and phasing-in of the MOMs. The personnel in the SRPO are already responsible for several roles and functions and we note that a number of retirements are imminent. Adequate budgetary and human resources should be identified for these efforts.

3. Serious Concerns Regarding Available Frequency Bands for Sounding Rocket Telemetry

Summary

Aware that S-band radio allocations for sounding rocket telemetry are threatened by growing demands for spectrum from commercial wireless services, the SRWG urges that steps be taken to ensure that the frequencies currently utilized by the program be preserved for scientific research under the auspices of the NASA Sounding Rocket Program. The SRWG also requests that the potential use of both X-band and C-band frequencies within NASA's rocket program be clarified, particularly as these frequencies enable the higher telemetry rates that are critical to an increasing number of missions in all science disciplines.

Background

The working group was advised that existing S-band radio allocations for sounding rocket telemetry are threatened by growing demands for spectrum from commercial wireless services. Consequently, there is a real chance that the entire band may be auctioned or otherwise made unavailable over the course of time in the U.S. and elsewhere. We note in related news that the EISCAT network of radars recently lost the protected status of its UHF frequencies, forcing the conversion of the mainland UHF radar to VHF and the attendant increase both in radar beamwidth and background noise level. The threats posed by the re-allocation of the radio spectrum in favor of commercial services is hence a real threat to scientific research.

Wallops engineers have been exploring conversion to X-band, a suitable choice for Wallops, Poker Flat, and Kwajalein, motivated by requests for ever-increasing telemetry rates. Using X-band for telemetry could be accomplished with readily available equipment and would afford a desirable increase in available bandwidth. Inquires along these lines to the National Telecommunications and Information Agency (NTIA) received a positive response. However, the SRWG learned at their January 2016 meeting that this effort has been met with resistance from NASA HQ headquarters for reasons that are unknown to the working group. This "pushback" appears to be related to X-band telemetry being reserved for cubesats but not for sounding rockets.

Another option for sounding rocket telemetry is C-band, the band already utilized by the US Department of Defense. Expanded bandwidth would also be afforded by the switch

to C-band, although new telemetry systems would have to be acquired and developed.

The SRWG urges that the S-band telemetry remain intact for as long as possible, particularly since proven hardware exists for both the payloads and ground stations. We furthermore request the clarification of the situation with respect to the utilization of X-band for telemetry and the possible reclassification of this band for both cubesats and sounding rockets. In any case, a decision regarding the choice of X- or C-band for sounding rocket telemetry should be made expediently, even if its first application will be simply to provide higher rates for specific missions.

4. Evolving Situation with Black Brants

Summary

The SRWG remains concerned over the problem of combustion instability in the Black Brant motor that has had a significant impact to achieving mission success. We recognize that the SRPO is clearly "on top" of this problem, as evidenced by the efforts to remedy the problems using Black Brant Mk 4 that were presented at the recent SRWG meeting. We agree with the SRPO that development of the Peregrine alternative should be continued in parallel with efforts to improve the Black Brant motor.

Background

The SRWG remains concerned over the problem of combustion instability in the Black Brant motor. Although recent manifestations of this problem have not all resulted in mission failures, in many cases they have led to significant damage to instruments and compromise of scientific return. We recognize that the SRPO has taken appropriate measures to address this problem within available resources, as summarized at the January, 2016 SWRG meeting. Clearly, it will take some time to discover whether the Brant Mk 4 has solved the problem. In the meantime, SRPO is prudently pursuing development of the Peregrine alternative in parallel with the continued improvements with the Black Brant. The SRWG supports this approach and will continue to monitor the situation and provide feedback as appropriate.

5. Subsystem Development Activities

Summary

The SRWG was pleased to learn of the new developments of several subsystems presented by the NSROC engineering team, particularly in the area of Guidance, Navigation, and Control. Although impressed with much of the development work presented at the meeting, the SRWG has two (related) concerns: (1) we are concerned about the large number of developments (i.e., new variants) of key, well-working sub-systems that are the backbone of the program, and (2) we would like to better understand the motivation for many of the upgrades currently underway and their assigned priorities.

Background

The SRWG was pleased to learn of the new developments on several subsystems presented by the NSROC engineering team. Standard subsystems are the technical bedrock of the sounding rocket program and are crucial elements to assure that mission goals can be met reliably while keeping costs low and schedules manageable. Evolving these subsystems is important in that prudent evolution provides for a multitude of benefits, including mitigation of component obsolescence, improved performance, enhanced reliability, greater usability, reduced size/weight/power, and diminished cost. An added benefit of this type of development activity is that it provides good growth and motivation opportunities for the technical staff by presenting new and varied challenges. The SRWG is enthusiastic about such developments in general.

The presentations we received at the January, 2016 SRWG meeting made it clear that several subsystems are in the midst of substantial development cycles, and perhaps no subsystem area is evolving more than Guidance, Navigation, and Control (GNC). Although impressed with much of the development work presented at the meeting, the SRWG has two concerns:

(1) Since standard subsystems play a critical role in the overall success of the sounding rocket program, we urge that recognized "working subsystems" not be discarded until new subsystem developments are thoroughly tested and their benefits are both understood and welcomed by the user community. Furthermore, having a large number of variants of each sub-system can become a challenge to manage.

(2) We would like to better understand the motivation for many of the upgrades currently underway. In particular, the user community (represented by the SRWG) would like some input to the "big picture" planning, and how priorities are set. For example, despite poor performance on a number of missions (e.g., 36.285 and 36.297) we still do not have a suitable alternative to the Xybion aspect camera needed for telescope missions.

NASA Sounding Rocket Working Group

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