Collaborative Workshop Advances Space Industry on Key Issues

By GAIL JOHNSON-ROTH
The Aerospace Corporation

The 2013 Mission Assurance Improvement Workshop attendees finalized five valuable, issue-specific mission assurance products during the April 30 to May 1 meeting. This sixth annual MAIW was hosted at Ball Aerospace & Technologies Corp. in Boulder, CO. The MAIW combines an industry and government collaboration with an issues-based approach to share best practices across the space community. The workshop represented the culmination of nine months of effort by five topic teams from government and 17 different space companies in addressing five significant mission assurance issues facing the U.S. space community.

The 2013 MAIW produced five outstanding products:

- **Electrical Design Worst Case Analysis Guidelines, Part 2:** Guidebook and standard (expectations), a continuation of effort from last year’s workshop and combining the two years of team effort. This document provides best practices for performing a successful worst-case analysis from basic principles to detailed guidance at the circuit level. It ensures analysis is consistent with evolving design, establishes planning for reviews, and provides consistent expectations between customers and analysts.

- **Lessons Learned and Corrective Actions for IC/Hybrid Failures:** Document providing details of reported hybrid failures with identified corrective action and presenting the recommended lessons learned from the study.

- **Architectures for Li-Ion Based Power Subsystems:** Guidelines defining power subsystem architectures for lithium-ion batteries for different class missions, providing the satellite developer with essential design considerations and verification tests needed to assure that a space vehicle has the capability to meet full mission while preventing, surviving, and recovering from power subsystem fault conditions.

- **Mission Assurance for Satellite Operations:** Guidelines for implementing mission assurance practices in mission operations from prelaunch through decommissioning; prevention

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Dawn of Improving Space Affordability

By ROBERT D. STRAIN
President, Ball Aerospace & Technologies Corp.

I can’t remember a time in my career when we weren’t talking about budget constraints. That said, I also can’t remember a time when the budget constraints were as acute as they are today.

How we respond to the federal budget challenges collectively and individually will dramatically change the aerospace industry. I am pleased that our response, at least in part, includes lively discussions about how we can fit within new budget profiles and continue to address our national needs. The Aerospace Corporation has played a vital role in initiating and maturing the dialogue.

U.S. Space Program Mission Assurance Summit 2013

November 13-14 at NRO HQ in Chantilly, VA

The Summit provides a forum for the top national security, civil, and commercial space sector leadership to collaborate, learn, and enhance mission assurance on all programs. This year’s theme—“Creating a More Affordable Enterprise: Best Practices for Lifecycle Mission Success”—is planned to put into operation the U.S. strategic approach regarding managing risk in a budget-focused environment.

Registration opens in early September. Look for your invitation to the MA Summit and register early to secure your space.
LESSONS LEARNED

Acoustic: To Test or Not to Test
By CHARLES WRIGHT
The Aerospace Corporation

Cost and schedule pressures on national security space (NSS) acquisitions often result in contractor recommendations to delete space vehicle level acceptance acoustic tests. An acoustic test typically consumes 7-10 days on the program critical path.

The Aerospace Corporation has reviewed several decades of NSS test data and concluded that the deletion of vehicle level acoustic test elevates mission risk. Space vehicle level acoustic testing uniquely identifies workmanship and interface defects on interfaces and mechanisms, often not tested at the unit level, that could lead to loss of space vehicle or severe, permanent flight degradation if launched undetected.

Interestingly, it is common practice among U.S. commercial space vehicle suppliers to perform both vehicle acoustic and vibration testing.

ACOUSTIC TEST EFFECTIVENESS

Acoustic test effectiveness (TE) data was first published by Smith (LMSC) in 1986. Smith found that in 81 LMSC vehicles, the test effectiveness was 0.78 mission degrading anomalies (MDAs)/vehicle. In 1988, a cross-industry study found 0.7 MDAs/vehicle on acceptance tested vehicles (Hamberg, Tosney). The European Space Agency reported, in 2008 using the Aerospace methodology as cited in a 2006 study, a TE of approximately 0.5 MDAs/vehicle. These reports show consistent test effectiveness, over 25 years, of approximately 0.6 MDAs/vehicle.

TEST DELETION CONSIDERATIONS

Within a block, deletion of the acoustic test can be considered if stability has been demonstrated in: factory production; design; manufacturing and assembly, integration, and test (AI&T) processes; supply chain products; acoustic dynamic response; and perceptive production process stability metrics implemented on first vehicle build. However, analysis shows that acoustic test deletion after five sequential, anomaly-free acceptance tests plus the necessary stabilized conditions results in a low residual risk to flight. Design, build process, and quality metrics must continue after a deletion decision to maintain the low risk to flight success.

CONCLUSIONS

The historical value of the acoustic test effectiveness of 0.6 MDAs/vehicle has been consistent, using the Aerospace/SMC methodology, for 25 years. Acoustic anomalies, although low in number, can lead to severe consequences in orbit if undetected on the ground. Deletion of acoustic testing

Strain

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about the role of Mission Assurance in a budget constrained environment. A recent example is the Mission Assurance Improvement Workshop that Ball Aerospace co-hosted with The Aerospace Corporation at the end of April.

There is a growing recognition that we can improve affordability through collaboration among mission assurance experts. Engaging thought leaders in government, academia, and industry enhances our understanding of common challenges and leads to the development of practical adaptations of how we do business.

For many years Ball Aerospace has advocated and adopted an approach that allows for tailoring. What I mean by tailoring is a clear-eyed understanding of risk at a mission level and how to prudently tailor processes to match an agreed-upon risk profile.

This approach opens many avenues for improving affordability. It also requires collaboration. There must be clarity about what is asked for and what is promised. All stakeholders must understand and be aligned on risk posture at the mission level.

There are excellent examples of industry’s ability to deliver affordable, high performance systems. Ball’s successful relationship with DigitalGlobe demonstrates what can be achieved when a customer and system integrator share an understanding of risk at a mission level.

Another step that could greatly contribute to affordability is government willingness to rely on industry approaches and processes. Industry has made significant improvements in its maturity. Many companies, including Ball, have invested in improving and optimizing their processes.

The development of a mission assurance community of practice has also contributed to industry’s advancement. This group uses an issue-based approach at the space enterprise level to collaboratively arrive at government/industry best practices for mission assurance processes, supporting disciplines, and associated products.

Allowing companies to optimize around industry-recognized best practices improves affordability by eliminating unnecessary formality. The government would also benefit from the experience and expertise of the workforce in industry.

We are just beginning to explore the ways that we can improve the affordability of space missions. I am encouraged that experts in mission assurance are taking a lead role. I support the ongoing dialogue and collaboration that is required to meet our nation’s needs.
Did You Know…

The Value Of Space Vehicle Level Thermal Vacuum (TVAC) Tests Is Consistently Recognized

Three studies on TVAC for space vehicles—one by Aerospace for the DOD, one by the European Space Agency (ESA), and one by the Japanese Space Agency (JAXA)—found that thermal vacuum tests uncovered an average of between 4.6 and 6.9 mission degrading anomalies (MDA) per test. A mission degrading failure is one that reduces the life or effectiveness of the mission or can lead to complete mission failure. Because TVAC is usually the last system level test before launch, if these failures had not been caught during TVAC, they might not have been found until the space vehicle was on orbit. In the study by Aerospace, 46% of the MDAs found were ones that should have been caught by subsystem or component testing but were missed.

SQIC Seeks Efficient Implementing of Counterfeit Parts Mitigation

By SUSAN HASTINGS
The Aerospace Corporation

The Space Quality Improvement Council (SQIC) met on May 30 in El Segundo, CA. The day’s agenda topics built on previous meetings of the SQIC and Space Supplier Council (SSC), so a summary of relevant discussions from the April 8 SSC was reviewed at the beginning of the day.

The SQIC members discussed the counterfeit parts law from the National Defense Authorization Act (NDAA) of 2012 as a large group. The discussion ranged from how to best mitigate counterfeiting to how to best implement the new law with the least impact on the supply chain. Generally accepted mitigation included use of original equipment manufacturers or authorized distributors to the maximum extent possible. The group acknowledged that use of brokers for sourcing is a last resort and requires additional mitigation. One member offered an alternative idea that a nation we could attack the problem by getting better control of recycled electronics, but that this approach would be larger than the space community. Another member pointed out that handling of counterfeit parts has been chosen as a Mission Assurance Improvement Workshop (MAIW) topic for 2014, and that as a community we need to figure out what the counterfeit avoidance and detection program requirements will be and then flow a consistent set of requirements to our supply chain.

Three small group discussions tackled issues affecting the space community. One small group exchanged views on lead-free solder and plating strategies in the supply chain. Lead-containing solders and plating are becoming more difficult and costly to obtain, and a suitable replacement has not been identified. The small group contained subject matter experts (SMEs), a government representative, and SQIC members. In preparation for the discussion, the SMEs provided summaries of the pertinent research and mitigation techniques. The group reviewed the material and recommended effective mitigation techniques for the near term and identified that an acceptable long-term strategy does not exist. Dave Davis from the Space and Missile Systems Center is planning to sponsor additional effort in this area to increase collaboration with other high reliability markets and to search for a viable long-term solution.

The most attended small group discussion addressed the communication strategy for mission assurance. This topic originated from remarks by Robert Strain, president of Ball Aerospace, at the Mission Assurance Summit. He stated that if we do not effectively communicate our mission assurance messages and products, we are doomed to continue to have the same discussions and make the same mistakes into the future. The group focused on improving communication relative to the MAIW.

Matteo Genna of Space Systems/Loral and Jeffrey

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on Class A/B NSS programs increases risk to mission success, but there is guidance on deletion considerations.

BIBLIOGRAPHY
3. Personal conversation with Christopher Kunstadter, 2011.

For more information, contact Charles Wright, 310.336.2259, charles.p.wright@aero.org.

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and recovery are two areas of concern in addressing process steps and products to ensure operations are ready to support; and a defined process to facilitate effective responses to satellite operational issues. This document provides best practices for future operations and assists teams in constructing and outlining processes necessary to increase mission success and minimize on-orbit risks.

• **Key Considerations for Mission Success for Class C/D Missions:** Guidelines to further define Class C and Class D missions in order to bound the perceived variability in acquisition approaches for experimental missions, based on a survey of negotiated baselines for current Class C and Class D mission planning and execution. This document provides key findings that will help shape an acquisition strategy consistent with mission class and reach alignment with the contractor team on program priorities.

The 2013 MAIW products are in final editing and the formal release process. Release of the products is expected by Oct. 30.

During the workshop, the MAIW Steering Committee selected the following topics to be addressed at the 2014 MAIW:

- RF Breakdown (Plasma, Multipaction) Guideline/Standard Development
- Design Integration of Ride-share Payloads—Do-No-Harm Analysis
- Counterfeit Parts Prevention Strategies
- Identification of Risk with Technical Consequences at Program Inception
- Root Cause Analysis Best Practices

Co-leads and the teams are being identified. The teams kicked off their nine-month effort at the beginning of August. The 2014 MAIW will be held May 7-8 at Orbital Sciences Corporation, Dulles, Virginia.

For more information, contact Russell Averill, 310.336.5865, russell.e.averill@aero.org.

**CALENDAR**

**SEP 2013**

Sep 10-12
AIAA SPACE 2013
San Diego, CA

Sep 16-19
JEDEC, Columbus, OH

Sep 16-19
AAQG/G-14 AAQSC Meeting, Seattle, WA

Sep 27
SAE 2013 Counterfeit Parts Avoidance Symposium
Montreal, Canada

**NOV 2013**

Nov 13
Joint SQIC/SSC
Chantilly, VA

Nov 13-14
MA Summit
Chantilly, VA

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Kincaid of Pratt & Whitney presented lessons learned from recent anomalies. Larry Wray provided a summary comparison of commercial operator environmental requirements; the work will be further discussed as part of the current update to Aerospace TR-2004(8583)-1 REV A “Test Requirements for Launch, Upper-Stage, and Space Vehicles,” often referred to as MIL STD 1540E.


For additional details on the SQIC, contact Terita Norton, 310.336.8803, terita.r.norton@aero.org.

Recent Guidance & Related Media

**BEST PRACTICES**

Evaluation and Comparison of Legacy and Modernized GPS Almanacs by T. Sharpe; TOR-2013(1590)-22; OK’d for USGC

Mission Assurance A/D Risk Tailoring Spreadsheet (MAAD RTS) by B. Shaw; TOR-2013-00132; OK’d for USGC


Mission Assurance Quick Reference Guide by G. Johnson-Roth; TOR-2013(8960)-5; OK’d for USGC

Adjacent-Band Interference to Consumer Radio Receivers by M. Tadjikov; TOR-2013-00046; OK’d for USGC

Orbit Transfers within Solar Exclusion Angles by M. Sorge; TOR-2013(1210)-3; OK’d for USGC

CubeSat Ammonia Release Experiment (CARE) by R. Stevens; TOR-2013-00192; OK’d for USGC

**SPECIAL REPORTS**

Space Quality Improvement Council Meeting 30 May 2013 by S. Hastings; TOR-2013-00449; OK’d for USGC

Cost Estimating of Space Science Missions by R. Bitten; ATR-2013-00108; OK’d for public release

The Space Situation Monitoring Laboratory—Web Based Space Environment Information and Analysis by J. Coggi; ATR-2013-00097; OK’d for public release

EFFECTIVENESS

Lifting of the products is to be addressed at the 2014 MAIW Steering Committee meeting. The work will be further discussed as part of the current update to Aerospace TR-2004(8583)-1 REV A “Test Requirements for Launch, Upper-Stage, and Space Vehicles,” often referred to as MIL STD 1540E.


For additional details on the SQIC, contact Terita Norton, 310.336.8803, terita.r.norton@aero.org.