The Precision Strike Digest

3rd Quarter 2010
Vol.23, No.3

"From Cruise Missiles Association to Precision Strike Association we have been dedicated to advancing the art and science of precision engagement concepts and technology for more than 20 years."

PSA
PRECISION STRIKE ASSOCIATION
Affiliate, National Defense Industrial Association

VISION STATEMENT

We aspire to be the premier association dedicated to advancing the art and science of precision engagement concepts and technology. To accomplish this, we will promote the development of systems and procedures in order to locate, fix, track, target, and attack fixed, moving, and relocatable targets. We recognize that battlespace management, the network within which it functions, and the adjunct command and control requirements are crucial to success on the battlefield. PSA has a global perspective and welcomes international participation.

PSTS-10 to Focus on Afghanistan

The precision strike community is very enthusiastic about the powerful program it has planned for its 20th Precision Strike Technology Symposium (PSTS-10).

This popular symposium will provide a stimulating venue for exchanging insights, experiences, and ideas that will showcase opportunities for the future of warfare regarding ***Precision Strike Technology Improvements for Meeting USCENTCOM's Needs in Afghanistan.***

PSTS-10, scheduled for October 27-28, 2010 at the JHU/APL Kossiakoff Center in Laurel, MD, will be conducted at the SECRET/NOFORN level both days.

PSTS-10 will include three hot-topic panels—***Precision Strike Operations in Afghanistan, Precision Strike Investments*** and the ***Nuclear Future***. These and other topics are highlighted on page 15 of this issue of the *Precision Strike Digest*.

As DoD continues to pursue the core objectives laid out in the 2010 Quadrennial Defense Review, PSA is focused on the large-scale, high priority security force assistance operations that are ongoing in Iraq and Afghanistan. We are providing needed support to our forces and continuing to make precision strike technological improvements to advance the ability to get needed capability to battlefield commanders now and in the future.

Vice Admiral Barry McCullough, USN

Lieutenant General John Mulholland, USA

Lieutenant General Chris Miller, USAF

PSA takes pride in featuring three very popular and gifted Defense leaders and visionaries-Vice Admiral Barry McCullough III, USN, Lieutenant General John Mulholland, USA and Lieutenant General Christopher Miller, USAF.

On the first morning, Vice Admiral McCullough will address the precision strike community on the cyber threat and operationalizing cyber. He serves both as the Commander, U.S. Fleet Cyber Command and Commander, U.S. 10th Fleet. He is a graduate of the U. S. Naval Academy and later completed Naval Nuclear Power Training and received a MS in Strategic Resource

See **Focus on Afghanistan,** Cont. on page 14

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Chairman's Column

As we entered the Fall season, we are faced with significant budget and employment uncertainty throughout the defense industry. One thing is certain; we're in for a round of belt tightening that we have not seen in recent memory.

This summer we addressed an important part of the kill chain that has long deserved our attention – the small UAS. Through an interesting collaboration between PMA-263, JHU/APL, AUVSI and PSA, we brought the Small UAS Symposium to our community. This symposium, held at JHU/APL, was an incredible success and we'd like to thank all of our partners for their efforts.

On October 27-28 we conduct our annual Precision Strike Technology Symposium (PSTS-10), focusing on technology improvements to meet USCENTCOM's needs in Afghanistan. At PSTS-10 you will hear about the future of precision weapons from defense leaders and technology experts who are engaged in the large-scale counterinsurgency, stability, and counter-terrorist operations in Afghanistan. We will also feature three superb panels – *Precision Strike Operations in Afghanistan*, *Precision Strike Investments*, *and Nuclear Future*.

If you are in town for the 2010 AUSA Annual Meeting & Exposition (Oct. 25-27), take time out at the end of the week to attend PSTS-10. For those in town for PSTS-10, make room for AUSA's excellent event. You will be amazed by the quantity and quality of displays and subjects covered. Attending both events will make for a busy week, but your time will be well spent. I guarantee you will not be disappointed.

Closing out on a rather sad note we recently said goodbye to an old friend, one of the Greatest Generation, that seem to be leaving us all too quickly. Please seek these folks out, they are living history and have so much to offer. Listen, learn and show how much you appreciate what they have done to secure our prosperity and freedom in the previous century. If heeded, the lessons they provide will keep us safe, free and prosperous in this century too.

Col. James E. Wilson, USMC (Ret), of Atlantic Beach, FL, passed away April 25, 2010. During his 31 years of service Col Wilson was a veteran of WWII, Korea, and Vietnam. He flew countless missions in the Pacific theater during WWII and was recognized for heroic aerial battles during the Korean Conflict, logging 60 missions within a 4 $^1/_2$ month period. Decorated 17 times, he received the Legion of Merit with Combat V, the Distinguished Flying Cross, three Air Medals, The Joint Service Medal, and the Navy Commendation Medal.

Semper fi, Jim. Semper fi.

Andy McHugh
Chairman of the Board
Precision Strike Association

Small UAS Symposium Wrapup

The Precision Strike Association (PSA), The Johns Hopkins University Applied Physics Laboratory and the Association for Unmanned Vehicle Systems International's DC Capitol Chapter held the second annual Small Unmanned Aircraft Systems (sUAS) Symposium June 22-24, 2010 at the Kossiakoff Conference Center, JHU/APL, Laurel, MD. Held at the unclassified level on June 22, all sessions on June 23-24 were classified SECRET/NOFORN. The event drew a total of 350 attendees.

The timely symposium took place as sUAS are proliferating at a remarkable pace, driven by the insatiable demand for Intelligence, Surveillance and Reconnaissance (ISR).

Small UAS operation is not exclusive to the Pentagon. Several federal agencies operate UAS, such as the Bureau of Land Management, Department of Homeland Security, Customs and Border Patrol, National Oceanic and Atmospheric Administration (NOAA), the U.S. Forestry Service and the U.S. Coast Guard (USCG).

The event focused on the Small UAS community (Group I, Group II, and Group III) with an understanding of the impact of existing, advancing and asymmetric threats in joint warfighting and Homeland Security. Topics discussed included: airspace deconfliction/integration, precision targeting/networking, operator workload/training, and mission systems.

The symposium featured keynote addresses by **Brig. Gen. William T. Crosby, USA**, the U.S. Army's Program Executive Officer (PEO) for Aviation, and **Captain J.R. Brown, USN**, the Program Manager for USN & USMC Small Tactical Unmanned Air Systems (PMA-263) within the Navy's PEO Strike Weapons & Unmanned Aviation (PEO(U&W) organization. They offered attendees the latest on small UAS R&D and procurement for the Army and Navy, respectively.

Brig. Gen. William T. Crosby, USA

Captain J.R. Brown, USN

Other presentations were made by military users of sUAS, reporting on current warfighting operations and 'lessons learned'. Service members presented acquisition plans & emerging requirements, while industry representatives and academia discussed technology opportunities. Exhibits displayed current sUAS products while the symposium offered 'networking' opportunities throughout the three-day event.

Stephen Waugh, Program Manager for ISR Platforms at JHU/APL—who along with **Bill D'Amico**, PhD, program manager-research & technology, JHU/APL—organized the unique symposium, welcomed the speakers and participants each day.

Stephen Waugh

First up on the podium was **Victor McCrary**, PhD, Business Area Executive for Science & Technology, JHU/APL, who in his welcome remarks said communications architecture and human/system interface are key to the sUAS community.

Bill D'Amico

He asked "how one obtains better mission persistence, enhancing one's ability to pursue additional objectives to the main mission objective, taking into account unexpected changes as they arise. Another key element to mission persistence is the agility of your platform," McCrary added.

Victor McCrary

McCrary said he'd love to see sUAS platforms with sensors able to do analysis on the fly and portable power sources that would enhance mission persistence. Firepower wins battles, but speed wins wars. UAS allows that type of speed," he believes.

In his capacity as PEO for Aviation, BG Crosby executes life cycle management of manned and unmanned aviation weapons systems for the U.S. Army. The current sUAS mix includes micro air vehicles, Wasp, Raven and Shadow systems. A Family of Systems Proof of Principle Demonstration may lead to conversion of the fielded Raven system to a sUAS mix of airframes (to also include Wasp and Puma) controlled by one ground control station. This would provide the small unit with enhanced situational awareness and increased force protection. Soldiers would choose the right airframe for a specific mission.

Regarding airspace integration of manned and unmanned aircraft, BG Crosby said "DoD needs to establish an effective and safe method for the UAS pilot to see and avoid other traffic. The immediate objective should allow for access to specific areas of the National Air Space (NAS). The ultimate goal is fielding of a "fully integrated solution that allows for unfettered access to the NAS to meet all DoD operational needs. Stated BG Crosby: "A simple, incremental approach is key."

CAPT Brown reiterated this as a singularly important point for sUAS—a common ground station is essential for good operational control and for cost control.

Session 1 began with a briefing on how college students are learning about small unmanned aircraft. **Joe Brannan**, president of AUVSI's Seafarer Chapter and director of the annual Student UAS Competition presented the winners of this year's event.

Joe Brannan

North Carolina State University, which has participated in all eight Student Unmanned Aircraft Systems Competitions, took home top honors this year, conquering past reigning winners.

The 10-person team flew their unmanned aircraft at Naval Air Station Patuxent River's Webster Field Annex in St Inigoes MD, during the June 16-20 competition. Made up mostly of aerospace engineering and computer science majors, team leader Himler Michel said that the team, which placed seventh last year, focused on their strengths this year to take the top honors.

"We try to stick with one platform for at least one to two years," said Michel, of their virtually carbon copy of their 2009 plane. "We focus as little as possible on the actual air vehicle and focus on the software."

Using the tail and wings from a stock remote control airplane attached to an in-house fuselage, the team autonomously took off and navigated, then completed in-flight waypoint changes and autonomously landed to take first place in the mission category of the competition.

Despite the team's eighth place oral presentation and sixth place/honorable mention journal completion, their flight was strong enough to propel them to the top spot overall, winning $9,700 in prize money.

CAPT Mark E. Reynolds, USCG, a career helicopter pilot with over 5,000 flight hours is currently assigned to the Coast Guard's Office of Aviation Forces, serving in a detached duty billet as the Unmanned Aeronautical Systems liaison to NAVAIR at NAS Patuxent River, MD.

He discussed how the USCG plans to utilize UAS both now and in the future both on land and on National Security Cutters (NSCs). CAPT Reynolds outlined the current requirements and mission set for UAS and the UAS concept of operations. In the near-term, he said, the USCG hopes to acquire some excess Raven sUAS from the U.S. Army to evaluate how they might enhance port security.

CAPT Mark E. Reynolds, USCG

A larger land-based UAS, perhaps the Predator, would provide persistent wide-area surveillance while a cutter-based UAS would offer tactical, beyond-the-horizon surveillance. He noted that the USCG is working towards a technology demonstration of the Northrop Grumman Fire Scout Tactical UAV on the NSC. The Bell Eagle Eye TUAV was to be deployed on the NSC, but technical problems scuttled that plan.

While still engaged in pre-acquisition activities, "we recognize that UAS is a force multiplier for us, will enhance our operations, providing a persistent maritime security presence," he said. "The USCG UAS acquisition strategy emphasizes commonality with existing Department of Homeland Security and Department of Defense programs," he emphasized.

Jim Schwierling, the Lead Projects Director in the Targets Management Office, Redstone Arsenal, AL, said the U.S. Army has developed, produced, and employed a series of low cost aerial targets to support test and training missions.

Jim Schwierling

As targets, these systems must be relatively easy to produce, resilient to use in field operations, provide acceptable performance for soldier training and to stress developmental weapon systems under test, and reasonably priced to allow for their repeated use and frequent destruction.

Two of the Army's aerial target systems provide the size and performance characteristics of Class 2 and Class 3 UAS in use, or in development.

The Outlaw Remotely Piloted Vehicle (RPV) Target is a low cost target system acquired primarily for Air Defense Artillery gunnery qualification training. Its size, performance, and cost have made it desirable for developmental systems under test and for force development test and evaluation exercises. Outlaw has been used as a surrogate for weapons system development and testing, and

it is an essential UAV surrogate representing Class 2 unmanned aircraft systems. It has been outfitted with landing gear, and EO/IR payload package, and additional avionics to provide a UAS low cost proficiency trainer.

The BroadSword UAS Target—developed to represent the size and performance characteristics of a Class 3 tactical class UAS—is used in developmental and operational testing of weapon systems.

He said both air vehicles are currently in production for the Targets Management Office. "We do not provide UAS. Rather, we provide aerial target systems that can be used as surrogate UAS," noted Schwierling.

Stephen A. Glowacki is the sUAS Special Federal Aviation Rule (SFAR) Part 107 Lead in the Federal Aviation Administration's Unmanned Aircraft Program Office. In this role, he is responsible for developing the first regulation written specifically for unmanned aircraft operations in the NAS.

Stephen A. Glowacki

He said allowing sUAS to fly in the NAS alongside manned aircraft is "a conservative first step" toward unfettered operations of all unmanned aircraft in skies over the United States.

Work on the sUAS rule began in August 2009. Glowacki said industry should see the Notice of Proposed Rulemaking (NPRM) for the sUAS SFAR Part 107 next year and the final rule in early 2013. That may seem tedious, but Glowacki said "FAA rulemaking averages 7-8 years, and we're trying to do this in five years. That's a very aggressive schedule."

The FAA considers Small UAS as 55 pound or less drones that are operated daylight visual line-of-sight by ground-based pilots under visual flight rule (VFR) conditions. sUAS will be limited to low altitudes and prohibited from operating over people and inhabited structures. They will also need to comply with air traffic control instructions.

Glowacki said the sUAS SFAR Part 107 will "enable the widest range of activity that can be safely conducted within the shortest rulemaking timeframe." The new federal aviation regulation will enable routine public, civil and commercial sUAS operations and sUAS makers will be able to mature their equipment toward certifiable standards.

The development of common sUAS ground control stations was the topic of **Larry G. Branthoover**'s presentation. The vice president of Defense Technologies, Inc. said as UASs prove their utility from the battlefield to natural disasters, stovepiped GCS limit operator access to the data and use.

Larry G. Branthoover

Receiving terminals such as Rover III, Video Scout, and OSRVT have opened the door for third parties to receive data, all with unique user interfaces and no payloads/vehicle control. He believes it is time to leverage standards and open architecture concepts defining key interfaces to open the door for warfighters.

This does not mean mandating one control station. It does mean more access by operators, ease of use, reduced training costs, increased data sharing and enabling manned/unmanned teaming. Common GCS provides the advantage of decentralized cooperation/coordination for situational awareness of unmanned vehicles and sensors to a distributed force.

An open architecture Common GCS opens the door for the development of operator tools and new control concepts, which generate innovation in the GCS. Flying by wave points limits autonomous, micro and multiple vehicle control.

His presentation summarized lessons learned while developing an Open Unmanned Mission Interface (OpenUMI). This software product was developed with an open architecture to control multiple heterogeneous unmanned vehicles.

OpenUMI was conceptualized from a clean slate with a focus on standards and the assumption of vehicles having a high level of autonomy. This still took three generations of the software to meet the open architecture objective. The future includes common payload control, Services Oriented Architecture (SOA) and rethinking control of autonomous vehicles.

Ricky E. "Ranger" Sward, a MITRE engineer, supports internal MITRE research projects dealing with command and control (C2) of sUAS.

Ricky E. Sward

Under current FAA regulations, said Sward, performing real, live-fly missions for sUAS is extremely limited and researchers building new C2 systems are often limited to simulated flights due to FAA restrictions. But MITRE has overcome this issue by transmitting real-time telemetry and video data from UAS missions flown at the USAF Academy, in Colorado Springs, CO, across the

MITRE network and by enabling C2 of UAS from MITRE research systems via the network. This network-enabled distribution of telemetry and video coupled with C2 from a geographically distant location is known as remote split operations.

Between October 2009 and March 2010, MITRE and students at the Air Force Academy successfully demonstrated remote split operations for small UAS. MITRE researchers in Bedford, MA, were able to receive the telemetry from a UAS flying over the Academy's airspace with minimal delays due to latency.

The researchers analyzed the telemetry and built new flight plans for the UAS. These flight plans were then sent to Colorado and uploaded to the UAS. Sward said researchers now have access to real, live-fly missions for sUAS without needing to find airspace, UAS platforms and UAS training. Researchers can now test C2 systems running on networks, access UAS telemetry and video data, and control UAS flying remotely.

Tony Harriman, Managing Director, EMSolutions, discussed Effects Based Operations Decision Support Services (EBODSS). He believes success in data fusion begins, not when the data starts to come in, but when planning the mission: selecting platforms and sensors and then working out an effective way to deploy them.

Tony Harriman

To get sensor reports that one can fuse into a useful picture of the battlefield, it is critical to have an ISR mission plan that takes into account the battlefield and the strengths and weaknesses of the available sensor platforms, types and modalities. Harriman said EBODSS, a decision aid being fielded under the guidance of ARDEC and AWG, can produce this kind of ISR mission plan.

Among other things, the EBODSS software application can deal with both unmanned aircraft and unmanned ground systems and cover the gamut of sensors, including seismic, acoustic and magnetic. It can assign platforms and sensors to tasks based on utility, deconflict sensors and aid UAS route planning.

The final presentation on the first (unclassified) day of the sUAS Symposium considered mind-controlled unmanned aircraft. **Richard Willmore** is a software engineer at Wyle Labs whose recent R&D projects include initiatives with electroencephalography (EEG) systems.

Richard Willmore

He said EEG devices have opened the door to thought interaction between one's mind and computers and vehicle systems. Devices exist that allow a user's thoughts to be trained and later identified.

He showed how EEG and its thought identification algorithms as a human interface device can send a series of infrared (IR) signals to a toy mind-controlled helicopter.

'Lift thoughts' from an individual produced enough power to lift the toy chopper off the ground while subsequent, well timed IR signals, established buoyancy as long as the user held this specific thought. It has been demonstrated that ten minutes of thought training is sufficient for an individual to successfully lift the helicopter with a single thought.

Willmore believes the success of this research project demonstrates the future possibilities of using EEG systems as human interface devices. Furthermore, interaction with such a device can be achieved covertly as no physical movement is necessary given well-placed EEG sensors on the scalp. However, only through repetitive thought training do these EEG systems become more accurate in identifying the occurrence of specific thoughts from an individual. Further work will improve the viability of repetitive thought identification algorithms for use as reliable human interface devices.

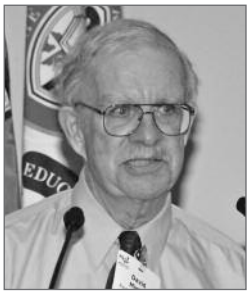
USMC Gunnery Sergeant J.R. Gonzalez, Marine Unmanned Aerial Vehicle Squadron 3 (VMU-3) Operations Chief, discussed the successful deployment of RQ-7B Shadow and ScanEagle unmanned aerial systems in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) between October 2009 and April 2010. These UAS were used to detect improvised explosive devices (IEDs), communications relay, and as unmanned 'wingmen' for piloted aircraft.

USMC Gunnery Sergeant J.R. Gonzalez

Larry Herbek, Sr. Engineer Analyst–UAS Division, SAIC, said the U.S. Army has been designated as the Activity Lead for Ground Based Sense and Avoid (GBSAA), a near-term solution for allowing some military UAS flights in the NAS. However, the goal is for unfettered access to the NAS. GBSAA is a ground-based means of detecting airborne traffic and providing the necessary intelligence to the UAS to mitigate or provide an alternative means of

Larry Herbek

compliance to the FAA's "see and avoid" regulations. He said the concept is being tested in the area around El Mirage Airfield in California.


David H. Minton

David H. Minton, Raytheon Missile Systems, spoke on multi-level security/cross domain information sssurance, examining the technologies available to develop and deliver a trusted embedded platform for the tactical edge, which can be certified and accredited as a Multi-Level Security/Cross Domain Solution (MLS/CDS) capability for a single level of separation.

Jeffrey Snyder

Jeffrey Snyder, Institute for Defense Analyses, reviewed existing and emerging communications methods available to developers of sUAS, which are precluded by their size from employing some of the radio devices used by the medium and larger UAS. The capabilities of sUAS depend upon the availability of avionics and adequate communications devices. There are many opportunities for innovation thanks to the rapid growth of commercial wireless communications. The capabilities of sUAS depend upon the availability of avionics and adequate communications devices. Snyder examined the potential of smart phones as a provider of command and control, avionics, mission automation, and communications and implications for future applications of sUAS.

Major Robert Bledsoe, USMC

Major Robert Bledsoe, USMC, Project Officer, PG-11, MARCORSYSCOM, outlined the various Marine UAS programs and UAS interoperability among Dragon Eye, Raven and Wasp, all hand-launched drones, and the larger RQ-7B Shadow UAS with a laser designator payload. He noted that the USMC is evaluating cargo-hauling UAS, the Boeing A-160 Hummingbird and an unmanned version of the Kaman KMAX rotorcraft. Other topics discussed included the combat-proven ROVER—the Remotely Operated Video Enhanced Receiver as applied to sUAS operation.

Doug Storsved, Chief Systems Engineer, ATK Advanced Weapons, discussed the role of an armed ISR UAS for the next generation Infantry Brigade Combat Team (IBCT). The RQ-7B weapons load might include multiple gliding miniature weapons, offering precision capability against movers and fleeing insurgents.

Doug Storsved

Major Spence McKenna, JCS J8 JIAMDO, discussed the Black Dart field demonstration series focused on counter–UAS capabilities across the wide spectrum of technologies for the full kill chain. Black Dart 2010 involved a total of 43 UAS and numerous active and passive sensors. Black Dart exercises are planned through FY2015, examining the entire C-UAS kill chain (detection, tracking, ID and negation).

Major Spence McKenna, JCS J8 JIAMDO

Lt Col Steve Tanner, USAF, with the Joint UAS Center of Excellence at Creech AFB, NV, spoke about Small UAS Joint Doctrine, which is facilitating the development and integration of common UAS operations while leveraging existing service initiatives to provide joint integrated solutions.

Lt Col Steve Tanner, USAF

Rose Mooney, AAI's UAS Director of Engineering Support, discussed successful flight testing of a company Shadow Ground Control Station with the GE Aviation 737 Fight Management System, which will ease acceptance of UAS into civil airspace. Flight tests verified FMS control of UAV similar to earlier simulations.

Rose Mooney

Kenneth Fidler, AMRDEC sUAS Team Lead, outlined near-term Army Small UAS Science & Technology planning, which includes fielding one OEF bound Brigade Combat Team with a sUAS proof-of-principle, replacing Raven drones with digital data links. The choice of Wasp, Puma and Raven drones offers soldiers mission flexibility. He also discussed consideration for a Rucksack Portable UAS involving short range micro, medium range and longer range unmanned systems.

Kenneth Fidler

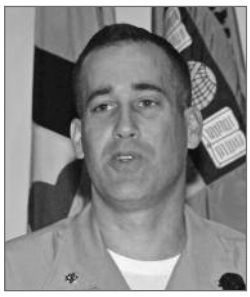
Brian K. Funk, JHU/APL project manager for the Joint Expeditionary Force Experiment 2010 (JEFX 10), discussed technologies that potentially fill capability gaps or addressed warfighter challenges in three capability areas (C&C, ISR and Force Application). He discussed the lessons learned for a Cooperative Hunter/Killer (CHK) UAS initiative and an Upstream Data Fusion (UDF) initiative. JEFX 10 demonstrated convoy protection using organic UAS assets.

Brian K. Funk

Captain Steve Perry, USN, branch head for submarine modernization, OPNAV N872, described how sUAS were utilized aboard the USS Santa Fe (SSN-763) to extend submarine ISR reach above water and over the horizon for ASUW targeting and SOF support.

Captain Steve Perry, USN

LtCol George Beach, USMC, HQMC, UAS Coordinator, offered a USMC UAS program update and discussed how Marines are using Dragon Eye, Raven and Wasp sUAS in a security role, for preraid and reconnaissance and covert observations.


LtCol George Beach, USMC

Al White, with Ticom Geomatics, said the sUAS platforms provide a tactical advantage for the Joint Signals Intelligence (SIGINT) Warfighter. The close proximity of the UAS to the threat emitter and the altitude advantage of the UAS compared to traditional ground intercept sensors translate into significant advantages for SIGINT operations. While tactical forces have long had access to products generated by Theater and National SIGINT assets they rarely have control over the scheduling or positioning of these assets to optimize results for unit-level operations. Advances in Mobile Ad-Hoc Communications, Multi-Level Security mechanisms and aggressive reductions in the size, weight, and power of SIGINT payloads have enabled unit-level sUAS platforms to provide on-demand, high-availability situational awareness and targeting capability that directly support the tactical mission.

James McCoy, with the NAVAIR Technology & Intelligence Office, briefed on Sono-Lunched (SL) and SL Air Deployable Sensor (SLADS) UAS development. The program aims to develop an organic sUAS that can extend maritime aircraft on-station time and enhance the range of aircraft sensors.

James McCoy

Earl Cox, a system engineer/program manager with AeroVironment, discussed digital data links as supplied on his company's Raven and Puma sUAS.

Earl Cox

Smartronix's **Qaisar Waraich** considered the effects of human factors engineering (HFE) on UAS operator performance in his doctoral dissertation from George Washington University. Among other things, his research is probing how operator performance can be influenced by UAS ground control station designs. His research shows that human factors have been the main contributor in many UAS crashes. Waraich believes additional research will help determine correlation between the application of HFE and UAS operator performance. ■

PSA would like to thank the following Corporations for Sponsoring and Exhibiting at the Small UAS Symposium:

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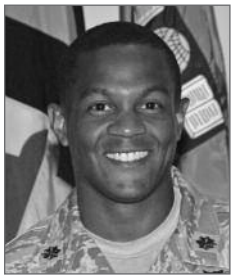
Speakers who presented at the classified level

Asad Khan/Mark Ritt
Precision Dropped Guided Mortar

Dallas Brooks
OSD UAS Airspace Integration

Dominic Marcelli
Black Dart History

1st Lt Bridget Brown, USAF
Secure Micro Digital Data Link



Major Tre Irick, USAF
USAF SUAS Integration with ISR Plans

Lieutenant John Chuma, USN
Small UAS Ops Aboard USS Porter DDG-78

Nov 2-4, 2010 Outreach Conference

Scientists, engineers invited to gain insight into latest counter-IED requirements

JIEDDO's Technologies Outreach Conference (JTOC) will take place at the Marriott Inn and Conference Center at University of Maryland in Hyattsville, MD.

JIEDDO's objective for this conference is to provide a forum for subject-matter experts within government, industry, academia and federal laboratories, as well as coalition partners, to network capabilities and expertise in a classified environment.

The JTOC offers attendees the opportunity to hear presentations ranging from a global threat update to a discussion of emerging threats from JIEDDO's Competitive Strategies Group.

To schedule an appointment for a one-on-one session, to learn more about the panel and general session topics, conference agenda and security clearance requirements, or to register for the conference visit the JTOC website at www.jieddo.dod.mil. ■

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Fuze Capability - Catching Up

By Charles Kelly, OSD-ATL, DoD Fuze IPT Chair

Future U.S. weapons need to be smaller, smarter, and more reliable while minimizing collateral damage. These requirements demand continued technological advancements throughout the portfolio of conventional weapons. Fuze capability through technology advancements has generally lagged behind other technology improvements made in U.S. weapons. The Joint Fuze Technology Program (JFTP) is a DoD science and technology program established this year to address fuze enabling technologies. Specifically, it addresses the technologies needed to address shortfalls in current weapon systems and priority capability areas as identified in the DoD's strategic guidance.

Shortfalls have developed in the areas of: integration with advanced weapons, miniaturization, harsh environment survivability and functionality, and smart electronics and processing. The JFTP ensures the focus and level of effort in fuze technology development reflects the prioritized needs identified by the DoD.

The establishment and governance of this program ensures that DoD efforts are leveraged to meet the Joint and individual Service needs. It will oversee the development, distribution, and use of technologies that will address miniaturization, shock hardening, and networking capabilities. The goal is to advance reliable, agile, adaptive, multi-mission robust solutions that include the use of micro-electromechanical systems (MEMS), integrated communications, hard and deeply buried target defeat sensing, advanced initiation schemes and quick reaction arming devices.

Under the JFTP, investments are focused in four capability areas: Hard Target Survivable Fuzing, Tailorable Effects Fuzing, High Reliability Fuzing, and Enabling Fuze Technologies & Common Architecture. Fuze Area Technology Groups (FATGs) under tri-Service leadership have been established and are developing technology roadmaps for each capability area that will be used to guide investments.

The JFTP provides a process that allows collaboration between components of the DoD, the Department of Energy, industry, and academia. The vehicle for industry involvement in the JFTP is the DoD Ordnance Technology Consortium.

FATG-I Hard Target / Survivable Fuzing

The first focus area of the JFTP is the development of fuze technologies for hard target defeat applications. There has been heightened emphasis on hard target defeat within the DoD due to the increased proliferation and advancing technology of hardened facilities around the world. Weapons and capabilities under development by the Air Force, Navy, and Defense Threat Reduction Agency exceed current fuzing technologies. Fuzes will need to survive and function at higher velocities and penetrate harder targets.

The Hard Target Fuzing challenges are grouped into three technology areas. Improved Modeling and Simulation Capabilities provide the validated computational tools necessary for hard target applications. Basic Phenomenology & Understanding of the Fuze Environment is the research to enhance the test equipment, instrumentation, and analysis techniques for experimentation and data gathering necessary for the third area, Hardware Development – Next Generation Fuzing. This final technology area aims to increase the effectiveness of facility denial munitions by miniaturization, unique architecture development, teradynamic sensor and algorithm research, and improved predictive computation tools and testing methodologies.

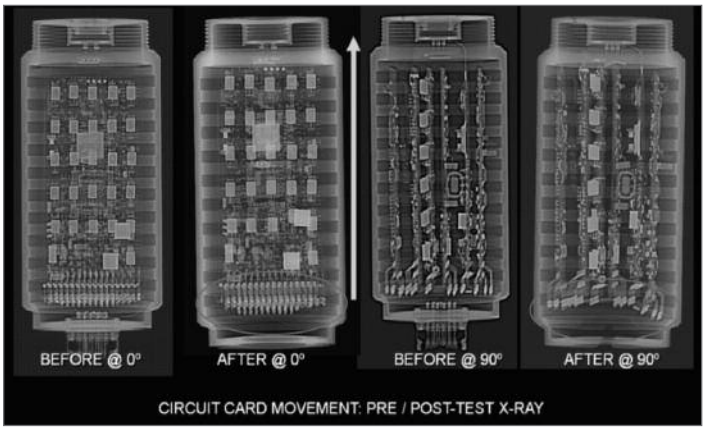
The first objective is to improve the modeling and simulation capabilities. The penetration environment experienced by the warhead, fuzewell, fuze, and fuze components during hard target attack is taxing the capabilities of current codes. Modal analysis of assemblies is one of the major areas of research to enhance computational capabilities. Modal analysis of individual parts is easily accomplished with current hydrocodes and structural codes, but the problem becomes much more difficult due to the presence of multiple mechanical structures and interfaces and the numerics of material interface algorithms in the codes. Accurate models of the variety of materials present (metal, explosives, potting, printed circuit boards, electronic components) are also necessary if a predictive tool is to be developed. The characteristics of these materials must be understood over temperature and within the extreme shock environment.

The second objective is the Basic Phenomenology & Understanding of the Fuze Environment. This technology area seeks to develop a thorough understanding of the

mechanical environment of a fuze during hard target penetration in order to optimize fuze survivability and functionality. The scope includes developing and applying new and emerging technologies that advance the state of the art for sensors, recorders, instrumentation systems, laboratory test techniques, multi-axial test devices, and data analysis techniques and target structure and weapon interaction.

The third objective is Hardware Development — Next Generation Fuzing. Development of smaller fuzes for enhanced survivability/functionality is an area of research. Increased reliability could be realized through the use of multiple/redundant fuzes as the fuze size decreases. Similarly, development of shock survivable modules for future fuzing applications that could have the fuze components collocated or distributed in the warhead is being looked at. This technology includes individual modules for sensing, initiation (i.e., hardened firesets), recording, power, etc. Non-inertial sensing concepts are being researched for target detection and void recognition. Also of interest is the development of concepts for incorporating multiple target detection devices for sensor fusion concepts.

Hardened Penetrator High Speed Sled Test



Fuze X-Ray Before and After High-G Penetration Tests

FATG-II Tailorable Effects Fuzing

The second focus area of the JFTP is to advance fuzing technologies necessary for two fundamental goals: 1) Tailorable Effects (TE) weapons; and 2) high performance initiation systems.

TE weapons capabilities are essential to deliver a focused lethal effect on the intended target while reducing unintended effects or collateral damage. Over the next five years, technologies are being pursued which will enable limited selectable yield options (high, medium and low) applicable to a few larger scale weapon applications. Potential transitions for JFTP TE investments include the next generation of the Guided Multiple Launch Rocket System and the Army Tactical Missile System. In the longer term, it is expected that there will be many more selectable yield options developed and that these will be employed on multiple applications.

The goal of developing fuze technologies to enable TE weapon systems will be achieved by focusing on three primary objectives: 1) advancement of in-line fuze system technologies for TE systems; 2) advancement of out-of-line fuze system technologies for TE systems; and 3) advancement of "smart" fuzing technologies for TE systems.

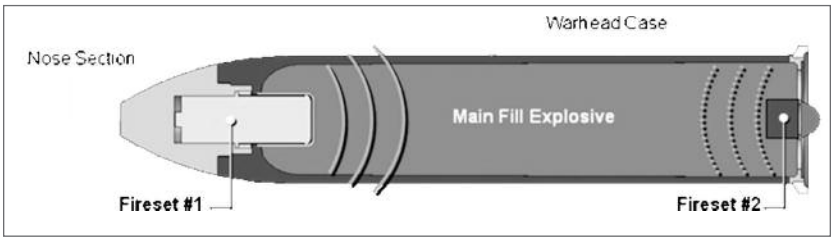
To advance in-line TE fuze system technologies, the efficient manipulation of ordnance output is being pursued by focusing on development of TE energetic components and development of in-line multipoint architectures for use in TE systems.

Relative to development of TE energetic components, the JFTP has funded several detonator and initiator programs. One is an initiator development effort being run by the Air Force Research Laboratory (AFRL) with team members Reynolds Systems, Inc. and Los Alamos National Laboratory (LANL). Another detonator approach is being conducted by LANL with the Naval Surface Warfare Center, Indian Head Division (NSWC-IHD).

Additionally, novel multi-point architectures are needed to tailor warhead effects through precision timing and detonation points. One such multi-point architecture effort being pursued by the JFTP addresses the technical challenges of voltage transmission efficiency and distribution of remote firesets. This effort is being conducted by a team comprised of Aviation and Missile Research Development and Engineering Center, Naval Air Warfare Center Weapons Division, and Sandia National Laboratory.

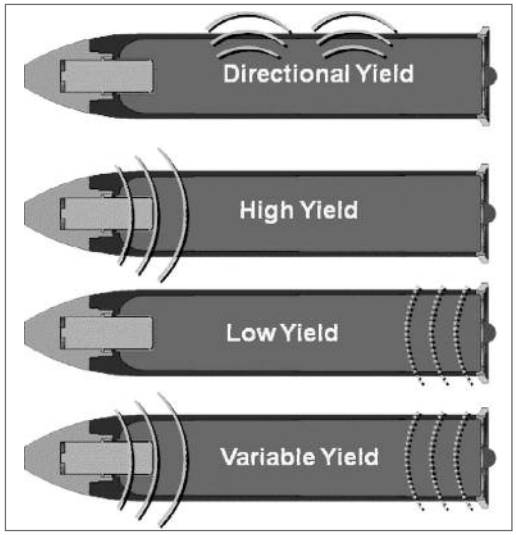
The advancement of out-of-line TE fuze system technologies is needed to optimize TE weapons through reduction of function time and function time variability of out-of-line energetic components. The JFTP is investing in a MEMS based initiator program led by NSWC-IHD that seeks to increase detonator performance through function time enhancements.

The third objective for advancement of TE fuze technologies addresses "smart" fuzing technologies. This objective will be accomplished by concentrating on target discriminating sensors (whose output could be used to



Tailorable Effect Warhead with Multi-Point Initiators

determine fuze operation for desired TE effect), Air-to-Ground and Air-to-Air engagement considerations, and sensor data fusion and advanced algorithm development for multi-point selectability application.



Selectable Yield Options for Tailorable Effects

The JFTP is currently investing in a program that is investigating the real-time classification of targets that provides feedback into fuze operation. This effort is being conducted by Army Research Development and Engineering Command (ARDEC) and the University of Florida.

Although highly related, the additional goal of advancing technologies for initiation systems is not limited to TE systems. This goal is being approached through one primary objective: improvement of weapon system fuze train performance. Fuze train performance can be improved by overcoming limitations of existing component technologies used in fuze firesets and through initiation of Insensitive Munitions (IM) materials.

The JFTP is making investment in the development of improved and advanced fireset components to improve fuze train performance. Integration of switching mechanisms and detonators is being pursued by NSWC-Dahlgren leveraging the DoD/DOE Joint Munitions Program efforts.

As the Defense community advances the state-of-the art in IM materials, fuzing must make advancements to include initiation of those more insensitive materials. Thus, the JFTP is considering several efforts related to initiation of main charge and booster fills. The JFTP will work closely with the Joint Insensitive Munitions Program so as to identify pertinent and mutually synergistic goals and approaches.

FATG-III High Reliability Fuzing

The third focus area of the JFTP is the development of highly reliable fuze technologies. DoD emphasis on increased weapon system reliability is evolving and is driving the need to consider new and novel approaches for achieving increased fuze reliability while maintaining or enhancing fuze design safety. DoD policy, higher weapon reliability expectations, and harsher weapon system operational requirements are dictating the need for higher fuze reliability than is available using current technologies.

The goal of high reliability fuzing will be achieved by focusing on three objectives; the development of reliable fuze architectures, fuze components, and next generation cluster munitions that result in less than one percent Unexploded Ordnance (UXO).

One of the current efforts in the development of highly reliable architectures is establishing physics based models and tools for quantifying the reliability of fuze specific electronic components. Another effort is the development of empirical techniques for establishing the reliability of the energetic components within a fuze.

To address fuze electronic components, the JFTP is funding researchers at the State University of New York Institute of Technology teamed with the University of Maryland to identify and establish techniques that can be applied to state-of-the-art Field Programmable Gate Arrays (FPGAs). These FPGAs are likely candidates for use in future fuze designs.

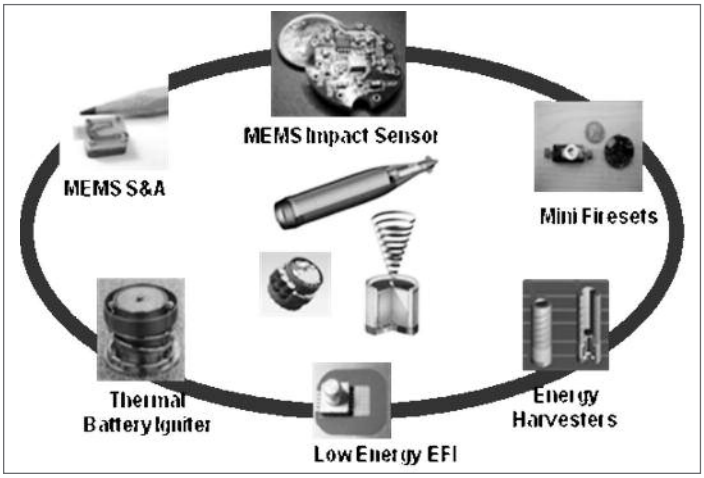
Additional research conducted at AFRL is focused on developing and refining physics based methodologies for characterizing and quantifying explosive transfer reliability within a typical fuze explosive train.

FATG-III's second objective is establishing very high reliability component technologies. The key to success in this area will be the utilization of commercially available (i.e. affordable) device technology that can be adapted to fuze application. Significant advancement has been made in recent years in micro-electronic packaging and sensor technologies.

A promising technology that merges microelectronics and mechanical sensing technology is MEMS. Both the Army and Navy have made significant advancements in the last five years in applying MEMS to munitions applications. Initial JFTP investment is leveraging the technology development funded by the Office of Naval

Research (ONR) and executed at NAVSEA Indian Head Division that is applying Deep Reactive Ion Etching (DRIE) MEMS based technology to fuzing. Researchers at Indian Head have teamed with the Army Research Lab (ARL) to advance DRIE MEMS fuze technology by developing wafer level packaging technology.

The third objective in the high reliability area is focused on technology development that can be applied to next generation cluster munitions which result in less than one percent UXO. Research in this area is being led by ARDEC and focused on the development of a next generation Dual-Purpose Improved Conventional Munitions (DPICM) for 105mm and 155mm artillery application. Research in this area leverages on-going Army technology investment made by the ARDEC Advanced Munition Technologies/DPICM Replacement Program.



High Reliability Fuze Technologies for Future Cluster Munitions

FATG-IV Enabling Fuze Technologies

The fourth focus area of the JFTP is the development of fuze enabling technologies. These enabling technologies have been selected to provide broad weapon applications through developing novel components, new modeling and simulation techniques, new proximity sensors, and power sources that will be needed to successfully field new fuze requirements associated with advanced performance and power. DoD emphasis on the increased use of electronics to achieve more complex fuze functionality is driving the need to consider new and novel approaches for generating enough power to meet this higher level of fuze performance requirements.

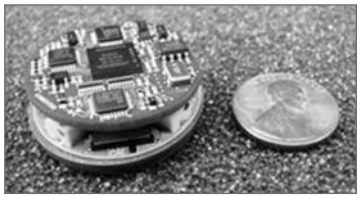
As a result, one goal of the enabling technologies portion of the JFTP is the development of new power sources for fuzes that can also be incorporated into a munition to meet power requirements associated with guidance and other electronic subsystems. To this end, two thrust areas are being pursued. One is the development of NanoFoil heated thin film thermal batteries; the other is the development of high power and high density supercapacitors.

Thin film thermal batteries are extremely small in volume, are conformable, and can provide enough power to meet the needs of low to medium-high power requirements in munitions. The project undertaken by the JFTP involves mating NanoFoil technology developed by ARL with Sandia National Laboratory's thin film battery technology to achieve a fast rise time thin film thermal battery that is also conformable.

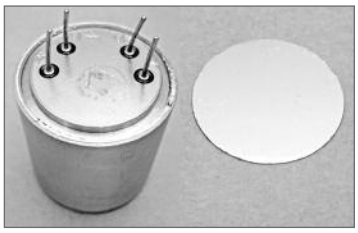
There are numerous potential munitions applications for this type of battery. Because of their small volumes and conformal characteristics, these batteries can be easily incorporated into many parts of a munition when combined with the addition of thermal insulation.

The second thrust area deals with the development of a new type of Electrochemical Double Layer Capacitor, or supercapacitor, which will have the characteristics of both capacitors and batteries.These devices can be rapidly charged, have high-energy capacity, and can provide high surge currents while maintaining voltage over long periods of time. Supercapacitors can supply energy through fuze setters to power or initialize guided munitions, and provide alternatives to one-shot type batteries.

The second main goal of the Enabling Technologies program is development of advanced sensors that will be incorporated into the next generation proximity fuzes. In order to accomplish this, the JFTP has established an Integrated Product Team (IPT), comprised of proximity sensor subject matter experts from each Service. The IPT is conducting an assessment to identify critical sensor and proximity fuzing technologies that can be applied across joint weapon applications. Candidate technologies include various types of sensors; RF, optical, IR, etc. The final determination on technologies will be complete in October, 2010 and will lead to follow on efforts during 2011. ■



Miniaturized software defined proximity sensor



NanoFoil Disk and Prototype Battery

News Briefs

DoD Efficiencies Initiative

Defense Secretary Robert M. Gates is putting meat on the bones of his initiative to reform the way the Pentagon does business and to eliminate duplicative, unnecessary overhead costs.

Money saved with these efficiencies will go back into funding needed military capabilities. "To be clear, the task before us is not to reduce the department's top-line budget," Gates said. "Rather, it is to significantly reduce its excess overhead costs and apply the savings to force structure and modernization."

The secretary is recommending eliminating U.S. Joint Forces Command. The command is the arbiter and proponent for joint training, doctrine and operations in the military, he said, but it means an extra layer in the bureaucracy.

Training and generating joint forces still is important, as is developing and testing joint doctrine. But it does not "require a separate four-star combatant command, which, in the case of [Joint Forces Command] entails about 2,800 military and civilian positions and roughly 3,000 contractors of all kinds at an annual cost of at least $240 million to operate," Gates said. ■

Amos Confirmed as Marine Corps Commandant

The Senate confirmed General James F. Amos as the 35th Marine Corps Commandant, to replace retiring General James T. Conway who has served in the post since NOV 2006. The voice vote makes Amos the first career aviation officer to hold the top Marine post. He is slated to be sworn in at Marine Barracks Washington at a ceremony on 22 OCT. ■

USAF Selects Raytheon for SDB II

The USAF selected Raytheon's GBU-53/B for the Small Diameter Bomb increment II program. The SDB II is an air-launched, precision-strike standoff weapon that will enable the warfighter to defeat moving and fixed targets in adverse weather conditions.

The $450 million contract calls for Raytheon's GBU-53/B to begin engineering manufacturing development. Delivery is expected to begin in 2013 with a required assets available date in late 2014. Raytheon's GBU-53/B incorporates an improved seeker that features three modes of operation: millimeter-wave radar, uncooled imaging infrared and semi-active laser.

Raytheon's SDB II was picked over a competing design by a team made up of Boeing—prime contractor for the first-generation Small Diameter Bomb—and Lockheed Martin. ■

CALENDAR OF EVENTS

Precision Strike Technology Symposium (PSTS-10) SECRET/NOFORN

Date: October 27-28, 2010

Theme: *Precision Strike Technology Improvements—Focusing on USCENTCOM's Needs*

Location: Johns Hopkins University Applied Physics Laboratory, Kossiakoff Center, Laurel, MD

Precision Strike Annual Review

Date: February 23-24, 2011

Location: Emerald Coast Conference Center, Ft. Walton Beach, FL

Precision Strike Armaments Technology Fire Power Forum

Date: June 14-15, 2011

Location: Hanover Marriott, Whippany, NJ

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Focus on Afghanistan,

Continued from page 1

Management from the Industrial College of the Armed Forces.

Opening day will also feature Lieutenant General John Mulholland, the Commanding General of the U.S. Army Special Operations Command. He will focus on what the special operator needs from precision strike. The Furman University graduate later earned a MS in National Security Strategy from the National War College.

USAF Lieutenant General Chris Miller, Deputy Chief of Staff for Strategic Plans and Programs, Headquarters USAF, is scheduled to present the keynote address on the second day of PSTS-10. He served as the senior USAF commander in Afghanistan—responsible for aircraft and airmen conducting joint and coalition reconstruction and combat operations.

The distinguished graduate of the U.S. Air Force Academy who subsequently earned a master's degree from Oxford University will address precision strike technology improvements for meeting USCENTCOM's needs in Afghanistan.

Additionally, the Director for Operations (J-3) on The Joint Staff has been invited to keynote PSTS-10 on Opening Day to talk about challenges for meeting USCENTCOM's needs.

Please join these distinguished Defense visionaries who will address this critical symposium that is widely credited as the best technology symposium of its kind! ■

PSTS-10 Program Highlights

PRECISION STRIKE TECHNOLOGY SYMPOSIUM (PSTS-10)

27-28 OCTOBER 2010

The Johns Hopkins University Applied Physics Lab
Kossiakoff Center • Laurel, MD

Precision Strike Technology Improvements—USCENTCOM's Needs in Afghanistan

PSTS-10 Showcases Three Critical Hot-Topic Panels:

Precision Strike Operations in Afghanistan

Precision Strike Investments—Supporting USCENTCOM's Current & Future Needs

Nuclear Future

PSTS-10 Highlights Six Technical Topics

Tactical Tomahawk—Call for Fire/Time Sensitive Strike Mission

Black Dart

Joint Surface Warfare JCTD—Operational Utility Assessments Results

Multi-Service Long Range Land Attack Projectile

Point Positioning Capability in IMEA v.2010

Developments in Electro-Magnetic Launch Technologies

PSTS-10 Features a Riveting Agenda of Additional Key Focus Areas:

Future of Precision Weapons—Emphasis on Winning the War

The Cyber Threat and Operationalizing Cyber

Challenges for Meeting USCENTCOM's Needs

Use of Spectrum for Precision Strike

What the Special Operator Needs from Precision Strike

Challenges in Calculating Collateral Damage

Precision Lethality MK-82 & 3rd Generation Weapons

Targeting Issues Related to the CENTCOM AOR

World Wide Infrastructure Overview Effort

Precision Strike Technology Improvements

Strategies for Winning the War against the Terror Masters

Conventional Weapons S&T Joint Assessment Team Process

Conventional Prompt Global Strike—Policy & Technological Challenges

Presentation of Award for Technical Excellence in the Field of Precision Strike during Luncheon on 1st Day

PSTS-10 will be conducted at the SECRET/NOFORN level

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