NAVAL AVIATION NEWS

THE FLAGSHIP PUBLICATION OF NAVAL AVIATION

F-35C: Fleet Carrier Qualified

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FALL 2016

Sailors perform routine maintenance on the rotor of an MH-60S Seahawk helicopter, assigned to the "Dusty Dogs" of Helicopter Sea Combat Squadron (HSC) 7, on the flight deck of aircraft carrier USS Dwight D. Eisenhower (CVN 69).

U.S. Navy photo by MCSA Joshua Murray

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ON THE COVER

An Aviation Boatswain's Mate (Handling) directs an F-35C Lightning II, assigned to the "Salty Dogs" of Air Test and Evaluation Squadron (VX) 23, to the catapult on the flight deck of aircraft carrier USS George Washington (CVN 73). (U.S. Navy photo by MC2 Kris R. Lindstrom) Read about the F-35C fleet carrier qualifications and the third and final developmental test phase on page 14.

This issue focuses on the future, starting with a detailed account of Naval Aviation's approach to identifying its next generation of air dominance capability in Flightline, written by Rear Adm. DeWolfe H. Miller III, our new Chief of Naval Operations' Director, Air Warfare (OPNAV N98). Learn how testing of a 100-percent advanced biofuel, page 17, and 3-D printing of a flight-critical part, page 26, enable future flexibility. The CMV-22B Osprey also demonstrates its flexibility during a Fleet Battle Experiment, page 13.

And we conclude our celebration of the 100th anniversary of the U.S. Naval Air Force Reserve on page 32 with "A Century of Service Part II" by Cmdr. Peter B. Mersky, USNR (Ret.).

***On the Back Cover**: The Navy's only forward-deployed aircraft carrier, USS Ronald Reagan (CVN 76), conducts flight operations in the South China Sea. (U.S. Navy photo by MC3 Ryan McFarlane)*

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Flightline

Future-focused: Next Generation Air Dominance

Rear Adm. DeWolfe H. Miller III
Chief of Naval Operations Director, Air Warfare (OPNAV N98)

This summer, I had the privilege to follow Rear Adm. Mike Manazir as the Chief of Naval Operations, Director, Air Warfare (OPNAV N98). Before returning to the Pentagon, I deployed as Commander, Carrier Strike Group (CSG) 2 on USS George H.W. Bush (CVN 77) where I was keenly aware of the immense flexibility, capability and capacity of our Sailors and the hardware they are entrusted to operate.

Having previous OPNAV experience, I realized then as I do now that there is an incredible amount time, effort and hard work that goes into procuring new technologies and developing and fielding existing and future capabilities. I am extremely impressed with how our elite team of warfighters and engineers continue to work with industry to mature promising technologies and deliver them to the fleet. The future of Naval Aviation is closely tied to our ability to seamlessly operate both with ourselves and our joint and coalition partners. We still have our work cut out for us. Maximizing our ability to train like we fight and execute operational missions with a fully integrated force is absolutely crucial to outpacing any threat around the world. As I settle into my new role, I remain excited and focused on the future.

Navy Next Generation Air Dominance

Since the crucible of World War II, Naval Aviation has remained forward and ready to address threats to our nation. Naval Aviation has adapted to address shifting strategic national priorities, respond to global contingencies, and shape the global security environment. During that time, the capability to conduct decisive air operations in the maritime domain and project power from the sea have remained essential elements in our nation's ability to deter conflict and win. To continue meeting our nation's needs, the Navy is exploring options for developing the next generation of airborne strike tactical aircraft systems.

The Navy's primary strike fighter and Airborne Electronic Attack (AEA) platforms, the F/A-18E/F Super Hornet and the EA-18G Growler, will approach their flight-hour design limits beginning in the late-2020s. Meanwhile, the Navy continues to manage service life while investing in follow-on capability improvements for the F/A-18. The Navy is full speed ahead integrating the extraordinary capabilities of the F-35C Lightning II into the carrier strike group. Despite these efforts, the Navy projects significant capability and capacity gaps in the future strike fighter and airborne electronic attack force in the 2030s.

U.S. Navy photo by MC2 Alex L. Smedegard

The Navy is full speed ahead integrating the extraordinary capabilities of the F-35C into the carrier strike group. Here, three F-35C Lightning II carrier variants, fly over aircraft carrier USS George Washington (CVN 73).

At the same time, technologies designed to counter U.S. military advantage and curtail U.S. access to global commons are proliferating among potential adversaries at an alarming rate:

> *By 2035 … parts of today's free and open commons may be disrupted by a combination of active opposition to existing norms, the maturation of anti-access and area denial capabilities, and the development of new power projection capabilities to control and manage these spaces.*[1]

Anti-access area denial (A2/AD) technologies, including high-energy systems, long-range and hypersonic weapons, advanced aircraft platforms, multi-spectral and multi-domain sensing and other emerging capabilities will stress the future maritime force. To assure access in the future, the Navy is exploring different solution concepts to support the capabilities required of the air wing and strike group of the future.

Setting the Stage

The systematic process of assessing the capability requirements and associated gaps of the 2030's Carrier Air Wing Strike Fighter force started in 2009. The Navy conducted a capabilities-based assessment study titled "Power Projection from the Sea." This analysis concluded that a family of systems would be needed to deliver the required aircraft carrier-based tactical aircraft capabilities of the future. Based on those findings, the Navy developed an initial capabilities document, or ICD, formalizing a "requirement" to address the projected operational gaps. The Navy's Next Generation Air Dominance (NGAD) Family of Systems ICD was approved by the Chief of Naval Operations in spring 2015 and validated by the Joint Staff in summer 2015.

This summer, the Navy began the NGAD Analysis of Alternatives (AoA) to formally identify potential materiel solutions and evaluate those alternatives based on cost, performance and supportability. The Navy's NGAD AoA is sponsored by the Chief of Naval Operations, Air Warfare Directorate (OPNAV N98) in coordination with the Secretary of the Navy's Deputy Assistant for Aviation—DASN(AIR). Naval Air Systems Command (NAVAIR) is executing the AoA with extensive external support and coordination across numerous external organizations and agencies. The AoA is scheduled to last 18 months and will conclude in early 2018.

Over the past two years, the Navy has been in exploratory discussions with research labs, research and development organizations and industry. Technical interchange topics include, but have not been limited to: derivative and developmental air vehicle designs, advanced engines, propulsion, thermal management, weapons, data-links, mission systems, electronic warfare systems and numerous other emerging technologies and concepts.

Insight Through Analysis

The analysis is expected to generate much more information on the emerging capabilities of systems of systems. A myriad of operational employment concepts will pull out the cost/performance tradespace across the future carrier air wing. At the same time, detailed analysis will generate timely insights into the structural capabilities and limitations of current and future systems.

Currently, the AoA is still considering the widest possible range of trades to balance capability, lethality, affordability and survivability. Categories of alternatives include investing in follow-on development of current planned systems and platforms; modifying or upgrading existing systems or platforms; and developing materiel capabilities in the form of new systems or platforms. The AoA is also evaluating manned, unmanned, optionally manned and "teamed" options to fulfill predicted mission requirements and meet expected threats. The solution may be comprised of a family of systems across multiple domains vice simply focusing on a single aviation platform. Equally important has been the detailed evaluation of techniques of operational analysis, cost and performance modeling tools and simulation to provide traceable decision-space for

[1] *Joint Operating Environment 2035, July 2016*

leadership. At this point, the Navy AoA team has not down-selected any categories of alternatives from the analysis.

The final AoA report will provide Navy leadership a recommended solution concept (or sets of solutions). Down the road, the recommended solution concept or concepts will become more specific, with detailed requirements, engineering parameters, and system attributes for a recommended system or system of systems. The solution concept may also guide an acquisition strategy, program plan, structure, execution goals and timeline. For now, the analysis is focused on generating the best options for the Navy.

Meanwhile, the Air Force is preparing to conduct a similar study. Although both the Navy and Air Force are performing independent analyses, the efforts are synchronized. The AoA teams openly share perspectives to functionalize interoperability, improve efficiency and effectively leverage the knowledge base of both services. This includes the sharing of technologies, analysis, modeling and simulation, threat assumptions and operational scenarios.

The Way Ahead

As America's first response team, the U.S. Navy cannot constrain itself to imagine only one potential future. It must be ready to adapt. The hallmark of Navy capabilities, and in particular Naval Aviation, is our flexibility to work across all spectrums of operations and all phases of combat to meet our nation's needs. A well-trained team of Sailors, aviators and operators acting in disciplined-yet-flexible combination with reliable technology will continue to generate naval superiority across the air and maritime domains to enable freedom of action and answer our nation's call.

U.S. Navy photo by MC3 Lorelei Vander Griend

Rear Adm. DeWolfe H. Miller III, became Chief of Naval Operations, Director, Air Warfare (OPNAV N98) in May. He hails from York, Pennsylvania, and graduated from the U.S. Naval Academy in 1981. He holds a Master of Science in National Resource Strategy from the National Defense University, is a national security management fellow of the Maxwell School of Citizenship and Public Affairs, Syracuse University, and is a graduate of the Navy's Nuclear Power Program.

Miller's command tours include Strike Fighter Squadron (VFA) 34, USS Nashville (LPD 13) and USS George H.W. Bush (CVN 77), and as a flag officer, Carrier Strike Group (CSG) 2 providing support to maritime security operations and combat operations for Operations Enduring Freedom and Iraqi Resolve.

Miller's operational tours began after earning his wings of gold in 1983 as a flight instructor with Training Squadron (VT) 19 in Meridian, Mississippi, followed by his first fleet assignment with Attack Squadron (VA) 56, flying the A-7E aboard USS Midway (CV 41) in Yokosuka, Japan. After transitioning to the F/A-18 in 1986, subsequent fleet tours included Strike Fighter Squadron (VFA) 25 on USS Constellation (CV 64), department head tour with VFA-131 aboard USS Dwight D. Eisenhower (CVN 69) and executive officer of USS Carl Vinson (CVN 70).

Miller's shore tours include F/A-18 test director at Air Test and Evaluation Squadron (VX) 5 in China Lake, California; special aviation programs analyst on the staff of the Chief of Naval Operations (N80); executive officer of Strike Fighter Weapons School Atlantic; deputy director of naval operations at the Combined Air Operations Center during Operation Allied Force; special assistant for Research and Development, Science and Technology and Operational Testing in the Office of Legislative Affairs for the Secretary of Defense; Aircraft Carrier Requirements officer for Commander, Naval Air Forces; and flag officer tours as director, Intelligence, Surveillance and Reconnaissance Capabilities Division and Assistant Deputy Chief of Naval Operations for Warfare Systems, both in the Office of Chief of Naval Operations.

His personal decorations include the Defense Superior Service Medal, Legion of Merit, Bronze Star, Meritorious Service Medal, Air Medal, Navy and Marine Corps Commendation Medal, Navy and Marine Corps Achievement Medal and various campaign, unit and service awards. He has accumulated more than 4,000 mishap-free flight hours and 877 carrier-arrested landings.

Grampaw Pettibone

Gramps from Yesteryear: September- October 2006

Illustration by Ted Wilbur

Hitting Hornets

Two F/A-18s along with another Hornet were going against a section of F-14 Tomcats on an air combat training hop. The lead Hornet, Dash-1, was positioned on the left side and the second, Dash-2, was in the middle, leaving Dash-3 on the right. Inside 10 miles of the merge (where friendly fighters meet enemy fighters) the range training officer informed both outside aircraft, Dash-1 and Dash-3, that they were simulated kills.

In accordance with Topgun adversary training rules at 5 miles from the merge, Dash-1 and Dash-3 did aileron rolls, acknowledging to all they were kills.

Dash-2 saw Dash-1 complete the rolls and shifted his lookout forward in an attempt to find the F-14s. Dash-2 started a left turn to put the opposing fighters within his missile's field of view, assuming that because Dash-1 had acknowledged the kill he would not maneuver approaching the merge. Dash-2 did not maintain a visual on Dash-1 and figured he would pass well below Dash-1.

Meanwhile, Dash-1 got a tally on the two Tomcats and continued straight ahead, ensuring a left-to-left pass with his opponents. At just under 3 miles from the merge, Dash-1 started more aileron rolls to ensure the F-14s knew he was out of the fight, a maneuver that caused the lead Hornet to lose 1,300 feet of altitude. Unaware that Dash-1 was descending toward him, Dash- 2 continued his turn for a weapon solution.

Just short of the merge, Dash-2 noticed Dash-1 was closing on him. He tried to avoid the collision but the two Hornets hit. (Dash-1 never saw Dash-2 before impact.) Miraculously, despite extensive damage to both aircraft, both pilots managed to coax their jets back to home base for emergency landings.

Grampaw Pettibone says ...

Fighter guys have an old saying: "Lost sight, lost fight." That was true in the biggest way here. Once he was called dead, Dash-1 had an obligation to remain predictable (and not descend 1,300 feet). Meanwhile, Dash-2—like everyone else in the event—had an obligation to be aware of where everyone was before maneuvering.

Once again the "big sky, little airplane" theory fails. Fortunately, they made it back, which is as much a testimony to how much plastic jets can bend as it is to the skill of these two pilots.

Airscoop

Compiled by Andrea Watters and Jeff Newman

Marines, Navy Take F-35 Testing to Next Level

WASHINGTON—Marine Operational Test and Evaluation Squadron (VMX) 1 led the way on exploring the interoperability of the F-35B Lightning II with naval technologies during operational tests (OT) this summer.

The Navy hosted its first live fire demonstration to test the integration of the F-35 Lightning II with existing Naval Integrated Fire Control-Counter Air (NIFC-CA) architecture Sept. 12.

During the test, an unmodified U.S. Marine Corps F-35B from VMX-1, based at Edwards Air Force Base, California, and formerly called VMX-22, acted as an elevated sensor to detect an over-the-horizon threat. The aircraft then sent data through its Multi-Function Advanced Data Link to a ground station connected to USS Desert Ship (LLS-1), a land-based launch facility designed to simulate a ship at sea. Using the latest Aegis Weapon System Baseline 9.C1 and a Standard Missile 6, the system successfully detected and engaged the target.

While the goal of this test was to prove the compatibility of these systems within existing NIFC-CA architecture, this future capability will extend the Navy's engagement range to detect, analyze and intercept targets in operational settings.

All three U.S. Air Force, Navy and Marine Corps F-35 variants can act as broad area sensors to significantly increase the Aegis capability to detect, track and engage.

"This test was a great opportunity to assess the Navy's ability to take unrelated technologies and successfully close the fire control loop as well as merge anti-surface and anti-air weapons into a single kill web that shares common sensors, links and weapons," said Anant Patel, major program manager for future combat systems in the Program Executive Office for Integrated Warfare Systems (PEO IWS).

The test was a collaborative effort across the Navy and Marine Corps, White Sands Missile Range and industry partners leveraging a U.S. Marine Corps F-35B and the U.S. Navy's Aegis Weapon System to support the distributed lethality concept in the fleet.

U.S. Air Force photo by Staff Sgt. Brandi Hansen

An F-35B Lightning II with Marine Operational Test & Evaluation Squadron 1 (VMX-1) on the flight line with an AIM-120 Advanced Medium-Range Air-to-Air Missile prepares for a round of Operational Test missile shots.

"This test represents the start of our exploration into the interoperability of the F-35B with other naval assets," said Lt. Col. Richard Rusnok, VMX-1 F-35B detachment officer in charge. "We believe the F-35B will drastically increase the situational awareness and lethality of the naval forces with which it will deploy in the very near future."

Increased Combat Capability Demonstrated

Earlier, 75 U.S. Marines from VMX-1's F-35B Detachment at Edwards and 21 members of the Joint Strike Fighter Operational Test Team (JOTT) conducted operational test missile shots of the AIM-120 Advanced Medium-Range Air-to-Air Missile from Aug. 9 through Sept. 1 while deployed to Eglin AFB, Florida.

These scenarios were different than earlier developmental tests since they were specifically designed around operational employment scenarios with the aim of further validating and developing tactics, techniques and procedures for all three F-35 variants.

"Due to the commonality of the F-35 mission systems and weapons, everything we learned during this detachment directly translates to combat capabilities for the Marine Corps, our sister services and partner countries," Rusnok said of the test missile shoot.

The detachment completed multiple engineering runs in preparation for the expenditure of five AIM-120 missiles and one Guided Bomb Unit (GBU)—12 LASER guided bomb. The operational test team developed complex air-to-air and air-to-ground scenarios and the F-35 weapons system performed as expected—delivering weapons on target.

On day one of live fire testing, the team shot two missiles on two separate test set-ups within a 12-minute span—an exceptional level of efficiency in a test environment. Another test involved an F-35B dropping a GBU-12 and supporting it with LASER guidance while simultaneously engaging a QF-16 drone. Both weapons were successfully guided to their targets.

These two events are integral steps to the F-35B's advancement and the future of Marine Corps Aviation.

Written by Program Executive Office Integrated Warfare Systems and Headquarters Marine Corps.

U.S., Canada: First RQ-21A Blackjack International Sale

PATUXENT RIVER, Md.—DoN recently signed an agreement with the Canadian Department of National Defense for the first RQ-21A Blackjack Unmanned Air System (UAS) international sale.

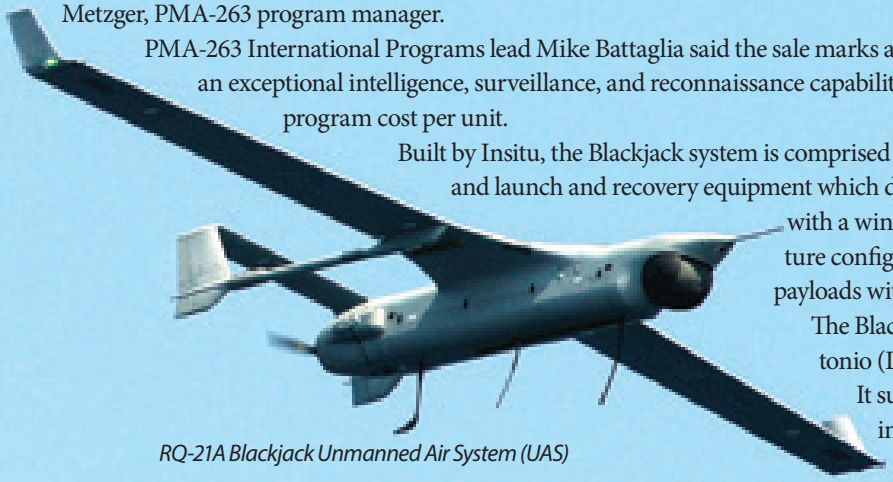
The Blackjack program, managed by the Navy and Marine Corps Small Tactical Unmanned Aircraft Systems Program Office (PMA-263), plans to deliver one system to the Canadian Army in 2017.

"We are very pleased to have our Canadian allies and neighbors as our first foreign military sales case and look forward to helping them grow their small tactical UAS capability and ensure maximum interoperability with our assets, if desired," said Col. Eldon Metzger, PMA-263 program manager.

PMA-263 International Programs lead Mike Battaglia said the sale marks a win for both countries. Canada is receiving an exceptional intelligence, surveillance, and reconnaissance capability while helping drive down the U.S. Blackjack program cost per unit.

Built by Insitu, the Blackjack system is comprised of five air vehicles, two ground control stations, and launch and recovery equipment which does not require a runway. At eight feet long and with a wingspan of 16 feet, the air vehicle's open-architecture configuration is designed to integrate multiple sensor payloads with an endurance of 10-to-12 hours.

The Blackjack is currently underway with USS San Antonio (LPD 17) for its maiden shipboard deployment. It successfully completed its first operational flight in early July.



RQ-21A Blackjack Unmanned Air System (UAS)

U.S. Navy photo by Sabrina Fine

Navy Receives Approval for Triton UAS Production

PATUXENT RIVER, Md.—The MQ-4C Triton unmanned aircraft system—the U.S. Navy's new persistent, high-altitude intelligence, surveillance and reconnaissance (ISR) platform—received approval Sept. 22 to enter into low rate initial production, the first part of the production and deployment phase.

Under Secretary of Defense for Acquisition, Technology and Logistics Frank Kendall made the decision, known as Milestone C.

"This milestone brings us closer to delivering a new capability to the fleet that will change the way our Navy executes ISR around the globe," said Sean Burke, Triton program manager. "Teamed with manned counterparts, Triton's highly capable sensor package will provide persistent maritime intelligence, surveillance and reconnaissance data collection and dissemination capabilities to the fleet."

The Triton will be a forward-deployed, land-based, autonomously operated system that provides persistent ISR within a range of 2,000 nautical miles using a multi-sensor mission payload including maritime radar, an electro-optical/infrared (EO/IR) camera, electronic support measures (ESM), an Automatic Identification System (AIS) receiver and basic communications relay.

"Triton's 24-hour on-station capability lets our other aircraft, such as the P-8 [Poseidon], focus more completely on their core missions," Burke said.

Triton is scheduled to deploy in fiscal year 2018.

U.S. Navy photo

An MQ-4C Triton prepares for flight at Naval Air Station Patuxent River, Md.

Swamp Foxes Conduct First Swing Loaded Operational Flight

Navy photo by MC3 J. Alexander Delgado

Sailors assigned to guided-missile cruiser USS San Jacinto (CG 56) load an AGM-114 Hellfire missile onto an MH-60R Seahawk Helicopter on the flight deck. U.S.

STRAIT OF BAB-EL-MANDEB—The "Swamp Foxes" of Helicopter Attack Squadron (HSM) 74 and the U.S. Navy saw an operational breakthrough July 12 when transiting through the Strait of Bab-el-Mandeb.

For the first time, an MH-60R Seahawk, the Navy's next-generation submarine hunter and surface attack helicopter, was swing loaded with both AGM-114 Hellfire missiles and Advanced Precision Kill Weapon System II (APKWS II) in an operational area.

Located between Yemen on the Arabian Peninsula and Djibouti and Eritrea in the Horn of Africa, the thin, 16-mile-wide strait sees an enormous amount of activity. Because it connects the Red Sea to the Gulf of Aden, it is an essential route of travel for the Navy, but can also prove a very dangerous one. An Arabic phrase meaning "Gate of Tears," Bab-el-Mandeb derives its name from its inherent navigational dangers.

"The swing load helps in some of the more dangerous chokepoints where we want the flexibility of different weapons systems," said Cmdr. Nicholas DeLeo, executive officer of HSM-74.

The APKWS II is a laser-guided rocket similar to standard Hellfire missiles, and serves as a low-cost, high-accuracy variant to the Hellfire missiles previously used against lightly armored targets.

"For MH-60R aircraft, the APKWS II adds a medium-range guided option to its robust weapons footprint," said Lt. Brian Crosby, HSM-74 tactics officer. "The MH-60R will employ APKWS II along with its existing Hellfire missiles and crew-served door guns, providing the warfare commander with a lethal and effective helicopter weapons system."

Swamp Foxes helicopters serve to bridge the gap between long-range weapons and the crew-served weapons aboard aircraft carrier USS Dwight D. Eisenhower (CVN 69). Swing loaded, the MH-60R has both the range and bulk of the Hellfire with the addition of the lighter and more numerous APKWS II. This means both small, close-range watercraft and farther, heavier targets can be effectively neutralized by one crew on one platform.

The Swamp Foxes are the first squadron on the East Coast to have the software capable of supporting both weapons systems on one helicopter. They are the first to put their training and their equipment to the test.

"This system has been briefed up to the highest levels of the Navy, and everyone has been extremely pleased with how HSM-74 has been able to utilize and prove the weapons," said Cmdr. Daniel Testa, HSM-74 commanding officer. "We've well surpassed all goals that we've set."

Mass Communication Specialist 3rd Class Cole Keller supports USS Dwight D. Eisenhower (CVN 69) Public Affairs.

New Test Range Operations Center to Increase Speed to Fleet

U.S. Navy photo by Adam Skoczylas

PATUXENT RIVER, Md.—Rear Adm. Shane Gahagan, commander, Naval Air Warfare Center Aircraft Division (NAWCAD), center, and Capt. Scott Starkey, commanding officer, Naval Air Station Patuxent River, lead representatives from their commands and the construction contractor in officially breaking ground on a new operations center for NAWCAD's Atlantic Test Ranges (ATR) Aug. 24. The project will enhance ATR's ability to support simultaneous test operations for current and future Naval Aviation programs, including unmanned systems and live, virtual, constructive battlespace environments. Reducing scheduling conflicts and providing more secure information-processing capability will support delivering new systems to the fleet faster.

P-8A Team Wins SECNAV Award for Environmental Compliance

PATUXENT RIVER, Md.—Assistant Secretary of the Navy (Energy, Installations & Environment) Dennis McGinn presented the P-8A environment, safety and occupational health (ESOH) team with the Secretary of the Navy's fiscal year 2015 environmental award for "Environmental Excellence in Weapon System Acquisition, Large Program" category Aug. 5.

The Maritime Patrol and Reconnaissance Program Office (PMA-290) integrated ESOH into the life-cycle management of its P-8A aircraft systems early in the acquisition cycle and streamlined hazardous materials tracking, among other accomplishments.

"The team's attention to detail, not only on the environmental side, but on how they addressed air pollution and reduced hazardous materials across the program while diving into the details was impressive," McGinn said. "Their dedication, talent and knowledge made a difference."

The team was presented with the Chief of Naval Operations award June 30. This is the team's fifth CNO award and second SECNAV award.

Currently, the program is focused on completing the transition of all P-3C Orion squadrons to P-8As. As of Aug. 9, the P-8A program delivered 42 production aircraft, supporting fleet transition and operational deployments. On average, 1.5 production aircraft are delivered per month. There are six test aircraft supporting system development, integration and test of P-8.

Improving the quality and usability of the information in the P-8A Hazardous Material Authorized Use List (HMAUL) was also a major accomplishment. The team collaborated with Jacksonville Fleet Support Team Logistics, Naval Air Systems Command (NAVAIR) Logistics and the NAVAIR Materials Engineering Division to reduce the number of line items in the HMAUL by 35 percent and decrease the number of items without national stock numbers by 67 percent.

The team has also extended its reach to the Royal Australian Air Force (RAAF), which has purchased the P-8A. With different hazardous materials and regulations than the U.S., the ESOH team is working with RAAF to track these materials and ensure compliance.

Written by Andrea Watters, editor, Naval Aviation News.

U.S. Navy photo by Adam Skoczylas

Assistant Secretary of the Navy (Energy, Installations & Environment) Dennis McGinn presents the P-8A environment safety and occupational health team with SECNAV's fiscal year 2015 environmental award for "Environmental Excellence in Weapon System Acquisition, Large Program" category. Accepting the award is team lead Michele Pok; Anneke Frederick, Chemistry and Analysis Branch; Tom Wilson, PMA-290/P-8A systems engineering integrated team lead; Rear Adm. Shane Gahagan, commander, Naval Air Warfare Center Aircraft Division and NAVAIR Assistant Commander for Research and Engineering. Second row from left, NAVAIR Commander Vice Adm. Paul Grosklags; Jeanelle Tortorice and John Maciejewski, both with the Chemistry and Analysis Branch; Capt. Tony Rossi, PMA-290 program manager; and Cmdr. Molly Boron, P-8A integrated program team co-lead.

The Italian Air Force's KC-767A refuels a U.S. Navy F/A-18 E/F during a test in early September at Naval Air Station Patuxent River, Md. This was one of several tests planned to authorize KC-767A refueling of U.S. Navy fighter aircraft in an operational environment.

U.S. Navy photo

U.S. Navy, Italian Air Force test aerial refueling capability

PATUXENT RIVER, Md.—Testing for the U.S. Navy's fighter aircraft to receive fuel midflight from the Italian Air Force's KC-767A aircraft is currently under way here.

This six-week test period is designed to meet U.S. Central Command's operational requirement for joint interoperability and increased air refueling capacity.

"It has been great to work with our Italian Air Force partners to strengthen our joint warfighting capability," said Capt. Jaime Engdahl, Naval Air Systems Command's Precision Strike Weapons program manager, who oversees the Navy's aerial refueling efforts. "With the team's continuing good work we will be able to clear all of our operational strike aircraft for coalition aerial refueling and extend our combat strike range capability."

"Testing is going very well and we are encouraged by the results we have seen so far with the F/A-18," said Erin Kennedy, PMA-201 aerial refueling class desk engineer. "In the weeks ahead, we will conduct additional flying quality evaluations with the AV-8B and EA-6B."

Ford Sailors Train to Trap

PATUXENT RIVER, Md.—Nineteen Sailors from Pre-Commissioning Unit Gerald R. Ford (CVN 78) graduated Aug. 31 from Advanced Arresting Gear (AAG) operator and maintainer initial training conducted at test sites in Lakehurst, New Jersey.

It was the second six-week course completed by Ford Sailors—20 graduated in April. Additional crew members completed a senior leadership training course in August 2015.

"AAG cuts down manning below deck during flight operations. We went from 22 people to three people, and that's a huge change for us," Aviation Boatswain's Mate (Equipment) (ABE) 1st Class Andrew Holcomb said. "There's also less maintenance needed, so we don't have to take apart as much greasy equipment and walk around the ship in dirty uniforms."

ABE2 Carlos Rodriguez said he thinks AAG will be safer for all personnel, but especially those working directly with it. Responsible for upkeep of the system aboard the Ford, Rodriguez said he valued the in-depth training because "topside, it's pretty much the same, but below decks, it's a completely different animal."

U.S. Navy photo

Sailors from Pre-Commissioning Unit Gerald R. Ford (CVN 78) use a test-site specific tool to lower the cable shock absorber thru-deck sheave assembly into place while participating in hands-on maintenance labs as part of a six-week Advanced Arresting Gear training course.

While anticipation for the system's benefits grows, many Sailors with previous experience working on the legacy linear hydraulic MK-7 said they were initially intimidated to work with the rotary hydroelectric AAG. However, a couple weeks into the course, many reported those anxieties were relieved.

"The intent of the training is to provide students with the most shipboard-representative, hands-on and job-related training possible in order to prepare them for system turnover onboard CVN 78," AAG training lead Dan Andreoli said.

The training combines classroom instruction with operation and maintenance labs and extensive walk-throughs at two active test sites. The CVN 78 crew has been involved and providing valuable input since early 2015.

"We have a very bright group of Sailors who will be operating and maintaining AAG, and I'm very proud to be a part of ensuring they have the proper foundation of knowledge and skills to safely and effectively operate and maintain the system," Andreoli said.

V-22 Osprey Demonstrates COD Flexibility

In preparation for replacing the C-2A Greyhound with the Navy variant CMV-22B Osprey as the Navy's carrier on-board delivery (COD) platform, Naval Air Forces completed a two-week Fleet Battle Experiment onboard USS Carl Vinson (CVN 70) Aug. 4.

"We look forward to the flexibility the CMV-22B will bring the carrier strike group," said Vice Adm. Mike Shoemaker, commander, Naval Air Forces. "The analysis and conclusions from this experiment will inform future concept of operations and how we will employ this aircraft and integrate it within the carrier air wing."

"The Osprey has a proven record in the Marine Corps, and we are looking forward to bringing its capabilities to our carrier strike groups," Shoemaker added.

A detachment of MV-22Bs from Marine Operational Test and Evaluation Squadron (VMX) 1 and Marine Helicopter Squadron (HMX) 1 were used during the experiment, which began July 22.

In preparation for the Fleet Battle Experiment, VMX-1 flew a V-22 aboard Vinson in June and conducted landings and takeoffs to familiarize the ship and aircraft crews with each other.

"These operations present an opportunity for our flight crews to gain experience landing on an aircraft carrier as opposed to landing on an amphibious ship," Marine Corps Lt. Col. Brett Hart, VMX-1's executive officer, said during the June operations. "It allows us to become accustomed to a different set of operating procedures, and additionally allows Air Department Sailors onboard Carl Vinson to become accustomed to landing and handling tiltrotor aircraft."

Since the Osprey is still a new platform for aircraft carriers, there were some things the flight deck crew had to be mindful of, particularly the extreme downwash generated by the V-22's tiltrotor engines, Hart said. "In fact, I would say it's even more extreme than an MH-53 [Sea Dragon helicopter], which can be dangerous," he said. "After today's operations, it's apparent that Carl Vinson's flight deck crew was prepared, and everyone involved with landing the aircraft seemed to be giving themselves a little extra room."

Notable advantages of the V-22 as the COD platform is its ability to deliver logistic support to the carrier at night, and its vertical takeoff and landing capability could allow it to directly deliver cargo to ships other than carriers. The Greyhound requires a full runway to land, and thus can only deliver to carriers. Currently, helicopters are used to disperse cargo from carriers to the rest of the strike group.

The Ospreys transported 34,590 pounds of cargo and 563 passengers to and from the ship during the experiment.

"I believe there's a lot of value added by having this aircraft onboard the ship. For being in the initial stages of evaluating the suitability of the V-22 to conduct the carrier on-board delivery mission, it went surprisingly well," said Cmdr. Lucas Kadar, Carl Vinson's air boss. "The Ospreys were able to integrate into the carrier environment seamlessly. It gives us a lot of options, a lot of flexibility, in the sense that we can recover it more as a helicopter or sometimes we can treat it more like a fixed-wing aircraft. The Ospreys bring the best of both worlds as far as the platform types go."

The Navy plans to buy 44 CMV-22Bs, with first delivery scheduled for 2020, followed by initial operational capability with the first detachment deployment in 2021.

Compiled by Jeff Newman, Naval Aviation News staff writer and editor.

U.S. Navy photo by MC Daniel P. Jackson Norgart

F-35C Completes First Fleet Carrier Quals, Final Sea Trials

By Donna Cipolloni

U.S. Navy photo by Donna Cipolloni

The no-frills C-2 Greyhound's arrested landing Aug. 15 aboard USS George Washington (CVN 73), deployed 100 miles offshore from Virginia, would more aptly be described by its journalist passengers as a "controlled crash" after the aircraft abruptly slammed onto the carrier's flight deck.

Invited to cover the third and final round of at-sea developmental testing, or DT-III, for the F-35C Lightning II—the Navy's carrier variant of the Joint Strike Fighter—our group disembarked and hurriedly crossed the flight deck where the powerful jet blast from two F-35Cs waiting to catapult off the bow only added to the already intense summer heat and humidity.

Operations were well underway as we reached our elevated vantage point on Vulture's Row where, in addition to phase three of testing, we would also witness Naval Aviation history as 12 pilots from the "Grim Reapers" of Strike Fighter Squadron (VFA) 101 out of Eglin Air Force Base, Florida, achieved the fleet's first F-35C carrier qualifications (CQ). Jet after jet thundered on and off the deck as each pilot knocked out two touch-and-go landings and 10 arrested landings in just a day and a half—a record pace compared to CQ with legacy aircraft.

"The work we did [during the two previous test phases at sea] directly fed what VFA-101 was able to come out and do today," explained Tom Briggs, lead flight test engineer with the F-35 Lightning II Integrated Test Force (ITF) at Naval Air Station Patuxent River, Maryland, and recipient of the 2015 Department of the Navy Lead Tester of the Year award. "For those of us involved in the program for quite a while, it was incredibly gratifying to see them come out and use that work to start making this aircraft real and get it out to the fleet."

Following CQ, four Navy test pilots and one Marine Corps pilot assigned to the "Salty Dogs" of Air Test and Evaluation Squadron (VX) 23 kicked off testing with their F-35 Pax River ITF teammates, who comprised a diverse group of technicians, maintainers, engineers, logisticians and support staff.

During the test period, which concluded Aug. 25, one week ahead of schedule, objectives included external symmetric and asymmetric weapons loads; launches and recoveries at maximum weight; approach handling qualities; night operations with the Gen III Helmet Mounted Display; landing systems certifications; and engine logistics. The Pax River ITF completed 100 percent of the 613 required DT-III test points during 41 flights that logged 39.7 flight hours over the course of 10 days.

Cmdr. Ted Dyckman, VX-23 test pilot, started out

"Jet after jet thundered on and off the deck as each pilot knocked out two touch-and-go landings and 10 arrested landings in just a day and a half—a record pace compared to carrier qualifications with legacy aircraft."

flying F/A-18 Hornets, moved to F/A-18 Super Hornets, and now flies the F-35C. It was his third ship trip and 50th trap—and he has a definite favorite.

"I prefer the F-35," he said. "It's easy to fly, autopilot is nice, cockpit has good visibility, and mission systems make it easy to do your task."

One of the most difficult and hazardous tasks in Naval Aviation is landing on the deck of an aircraft carrier, something now made simpler by Delta Flight Path, a semi-automated landing mode developed by Lockheed Martin in collaboration with Naval Air Systems Command that significantly lowers a pilot's workload.

"The control laws allow aircraft to fly a commanded glide slope," Dyckman said. "Before, you had to manually fly that path through the air. Now, at the push of a button, the airplane will tip over and fly that path. If I have a good approach behind ship, I can push one button. If there are deviations, I can make a correction. Other than that, I may not touch the stick at all during the approach, from the start until touchdown. Coming to the ship is as easy as landing on an airfield now and that enables us to spend less time training guys to land on the ship."

Other testing involved improved nighttime visibility for the aircraft's third generation helmet, which displays symbology right on the pilot's visor.

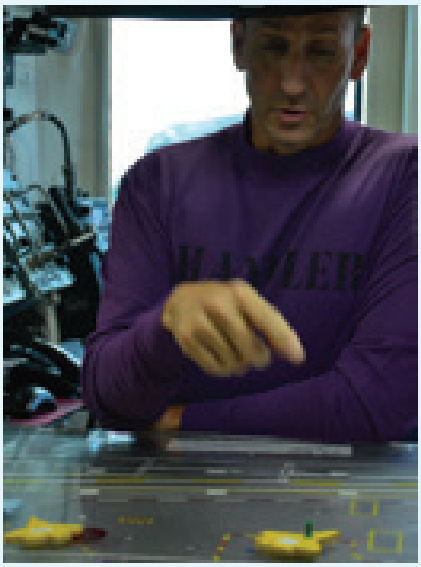
"I don't have to look down for a piece of info on one display, then to another display and correlate it all in my head; everything appears in the helmet," Dyckman said. "When I look out, even if I'm looking away from where I'm going, I can see my target information, airspeed, altitude, threats. With this airplane, I basically have a display with my aircraft in the center and it presents information for situational awareness."

Test pilot Lt. Cmdr. Daniel Kitts, officer in charge of the VX-23 test detachment, noted three things about the F-35C that excite him.

"The ability to bring the aircraft back aboard the ship safely the first time, every time for the most junior

U. S. Navy photo by MC2 Kris R. Lindstrom

Sailors prepare to launch an F-35C Lightning II carrier variant assigned to the "Grim Reapers" of Strike Fighter Squadron (VFA) 101, the Navy's F-35C fleet replacement squadron, off the flight deck of USS George Washington (CVN 73).



U. S. Navy photo by Donna Cipolloni

Handler Lt. Cmdr. Greg Curl directs the movement of two F-35Cs from VX-23 and five F-35Cs from VFA-101 aboard the flight deck of USS George Washington (CVN 73).

U. S. Navy photo by Donna Cipolloni

As an F-35C from VX-23 prepares to be catapulted, two F-35C aircraft from VFA-101 await their turn.

What it's Like to Fly the Navy's F-35C

Navy Live BLOG recently caught up with Lt. Nicholas Rezendes, a U.S. Navy fighter pilot assigned to Strike Fighter Squadron (VFA) 101 located at Eglin Air Force Base, Florida. On Aug. 14, he participated in carrier qualifications for the F-35C Lightning II carrier variant aboard USS George Washington (CVN 73).

The best part of my job as a naval aviator is, for sure, being able to hop in a jet and leave all of life's other concerns behind. Allowing yourself to focus completely on the task at hand can be therapeutic.

I have flown a handful of different aircraft, starting out in flight training with the T-34C Turbo Mentor and the T-45A and C Goshawks. After receiving my wings, I flew the F/A-18C Hornet with Strike Fighter Squadron (VFA) 113. Now, I'm flying the F-35C Lightning II. And just like that sounds, the F-35C is leaps and bounds ahead of what I've grown accustomed to.

The F-35C is a stealth aircraft with powerful avionics that are at the cutting edge of technology. The F/A-18C was at the cutting edge in the '90s, but the venerable Hornet is showing its age after more than two decades; so you can imagine the difference.

Regardless, ignoring the tactical capabilities of the F-35, it is a similar piloting experience to most of the other jet aircraft I have flown. The giant touch screen is a big advantage—it has certainly got me feeling spoiled. As much as I'll always love the legacy F/A-18C, I have to admit that I would probably feel a bit disappointed if I went back to using the smaller, all-green displays in the Hornet.

Every carrier aviator faces the same challenges prior to going to the ship; each one of us gets nervous every time. Now, factor in that we're conducting carrier qualifications with a new platform. You can see that we're operating in a high-pressure and unforgiving environment that requires 100 percent focus from the pilots to the maintainers.

The best part of participating in the F-35C's carrier qualification is witnessing firsthand such a major, significant evolution in carrier aviation. The Lightning II is outfitted with a landing mode that greatly enhances the pilot's ability to safely land aboard an aircraft carrier—a feature that has been developed alongside a similar program for the F/A-18 Super Hornet, known as MAGIC CARPET. The precise landing capabilities granted by these programs come as close as possible to simplifying the most demanding aspects of shipboard recovery.

U. S. Navy photo

Lt. Nicholas Rezendes

Leading up to the carrier qualifications, I was particularly excited to see how this jet handled behind the aircraft carrier. It really exceeded my expectations. Having only previously conducted arrested landings in Hornets, the comparison between the two was night and day.

The F-35C brings a multitude of tactical mission sets to the U.S. Navy, and will prove to be a lethal and capable asset to carrier air wings. I'm both proud and excited to be a participant in this history.

Lt. Rezendes, a native of Berkley, Massachusetts, graduated with a degree in criminal justice from Northeastern University in Boston. He earned his commission through Officer Candidate School in 2008. In 2011, he finished flight school in Kingsville, Texas. He deployed aboard USS Carl Vinson (CVN 70) in support of Operation Inherent Resolve in the Arabian Gulf from 2014 to 2015.

pilot to the most senior is one of its major advantages," Kitts said. "Also, the incorporation of its mission systems to the pilot and the fusion of that information is really going to make it a lethal tactical platform; and its ability to share that information with other assets in the fleet is going to help build the picture for the whole carrier strike group. Not to mention, we're bringing a stealthy airplane to the carrier decks for the first time."

The F-35C's unprecedented stealth-at-sea capability delivers an advantage for penetrating threat envelopes, and its ability to detect and fuse information from many sensors—and link that fused picture to other carrier strike group aircraft, ships and other decision makers—is a game changer, noted Commander of Naval Air Forces, Vice Adm. Mike Shoemaker, while speaking Aug. 18 to an audience at the Center for Strategic and International Studies in Washington, D.C.

"The F-35's performance aboard USS George Washington is giving us the ability to look at the way we conduct work-ups and potentially expand the number of sorties," Shoemaker said. "It will change the way we operate around the ship and change the number of tankers required for daytime and nighttime. The F-35 will give us a lot of flexibility in the air wing and in the way we use those strike fighters."

DT-III was an incremental buildup over five years of work from the Pax River ITF team, beginning with the first aircraft's initial onshore catapult and arresting gear testing, and ending with the hundreds of operational cats and traps that recently took place aboard Washington. Having completed the gross weights and load up testing necessary to equip the fleet with a full launch and recovery bulletin, it was the final phase of testing.

"It's going to be a viable aircraft that's going to do what it's been designed to do," Briggs said.

The Navy is expected to declare initial operational capability in 2018.

Donna Cipolloni is a staff writer for the Naval Air Station Patuxent River, Maryland, Tester newspaper.

Navy Tests 100-percent ADVANCED BIOFUEL

Drop-in JP-5 jet fuel replacement 'invisible to user'

By Andrea Watters

Lt. Cmdr. Bradley Fairfax, project officer and test pilot with Air Test and Evaluation Squadron (VX) 23, takes flight in an EA-18G Growler on 100-percent alternative biofuel during the first test flight Sept. 1 at Naval Air Station Patuxent River, Md.

U.S. Navy photo by Adam Skoczylas

The Secretary of the Navy's energy vision came to fruition in September when the EA-18G "Green Growler" completed flight testing of a 100-percent advanced biofuel at Naval Air Station Patuxent River, Maryland.

"From takeoff to landing, you couldn't tell any difference," said Lt. Cmdr. Bradley Fairfax, project officer and test pilot with Air Test and Evaluation Squadron (VX) 23, after the first test flight Sept. 1. "The information presented to us in the airplane is pretty simplified, but as far as I could tell, the aircraft flew completely the same as [petroleum-based] JP-5 for the whole flight."

Using the Naval Air Warfare Center Aircraft Division's (NAWCAD) Real-time Telemetry Processing System (RTPS) at the Atlantic Test Ranges, flight test engineer Mary Picard monitored the ground and test flights and confirmed Fairfax's observations. "What we have seen is that the 100-percent bio-JP-5 appears to be basically transparent. It looks exactly like petroleum JP-5 in the airplane; it performs the same, and we haven't noticed a difference."

And that's the technical premise of the Navy's alternative fuels test and qualification program: the JP-5 produced from alternative sources must be invisible to the user, said Rick Kamin, Energy and Fuels lead for Naval Air Systems Command (NAVAIR). Kamin also leads the alternative fuel test and qualification program for the Navy.

Prior to the first test flight, the catalytic hydrothermal conversion-to-jet (CHCJ) process 100-percent alternative fuel performed as expected during ground test Aug. 30 at NAWCAD's Aircraft Test and Evaluation Facility.

U.S. Navy photos by Dan Owens

As part of test protocol, Aaron Williams, with Air Test and Evaluation Squadron (VX) 23 maintenance department, siphons a sample of the 100-percent alternative biofuel during ground test Aug. 30 at Naval Air Warfare Center Aircraft Division's Aircraft Test and Evaluation Facility. Right, the bottle contains the clear, 100-percent advanced biofuel created by Florida-based Applied Research Associates and Chevron Lummus Global's catalytic hydrothermal conversion-to-jet (CHCJ) process.

"Today is a further example of how the Navy and Marine Corps continue to lead in energy innovation, and in doing so, remain the greatest expeditionary fighting force the world has ever known," said Secretary of the Navy Ray Mabus.

The fuels program supports SECNAV's operational energy goal to increase the use of alternative fuels afloat by 2020.

"As the owner of the JP-5 aviation jet fuel specification, our job at NAVAIR is to make sure that whatever source our JP-5 is made from, we know it will work in our aircraft," Kamin said.

"This is the first time we've looked at a process that can produce a fuel with all the properties and chemistry of JP-5 jet fuel without having to blend with petroleum-based JP-5," said Kamin.

CHCJ is produced by Florida-based Applied Research Associates (ARA) and Chevron Lummus Global. ARA's process uses the same feedstocks as the Hydroprocessed Esters and Fatty Acids (HEFA) 50-percent advanced biofuel blend previously approved by the Navy, but goes through a unique conversion process that provides a fully synthetic fuel that does not need to be blended, Kamin said.

The first biofuel process evaluated in 2010 was HEFA, which produces biofuel from oil seed plants, algae, tallow and waste oils. While not specified by the Navy, camelina seeds (*Camelina sativa*) were used to produce the test fuel. However, since the HEFA product did not have all the properties of JP-5—particularly aromatic compounds—it had to be blended 50/50, Kamin said.

CHCJ starts with feedstocks including algal oils, tallows and plant oils such as carinata *(Brassica carinata)*, waste vegetable oils, canola oils and distillers' grain oils. These feedstocks undergo a catalytic hydrothermolysis process, which uniquely converts the starting materials into a mixture that primarily contains the variety of hydrocarbons essential for jet fuel (aromatic, paraffinic and olefinic compounds). The final hydrogenation and fractionation steps convert or remove unwanted compounds from the intermediate process stream so that the finished product is an on-specification, fit-for-use fuel.

"We are excited to work with the U.S. Navy as it takes this important step toward the use of 100-percent drop-in renewable jet and diesel fuels in its aircraft and ships," said Chuck Red, vice president of fuels development for ARA. "Our renewable fuels continue to prove their viability as 100-percent replacements for petroleum in diesel and jet fuel applications."

JP-5 is exclusively used by navies because it is specifically refined with a higher flash point for additional safety at sea. A primary need is that all candidates must be drop-in replacements that meet the following criteria:

- No changes to Navy equipment
- No impacts to performance or operability
- No incompatibilities with current fuel stocks
- No changes for the end user

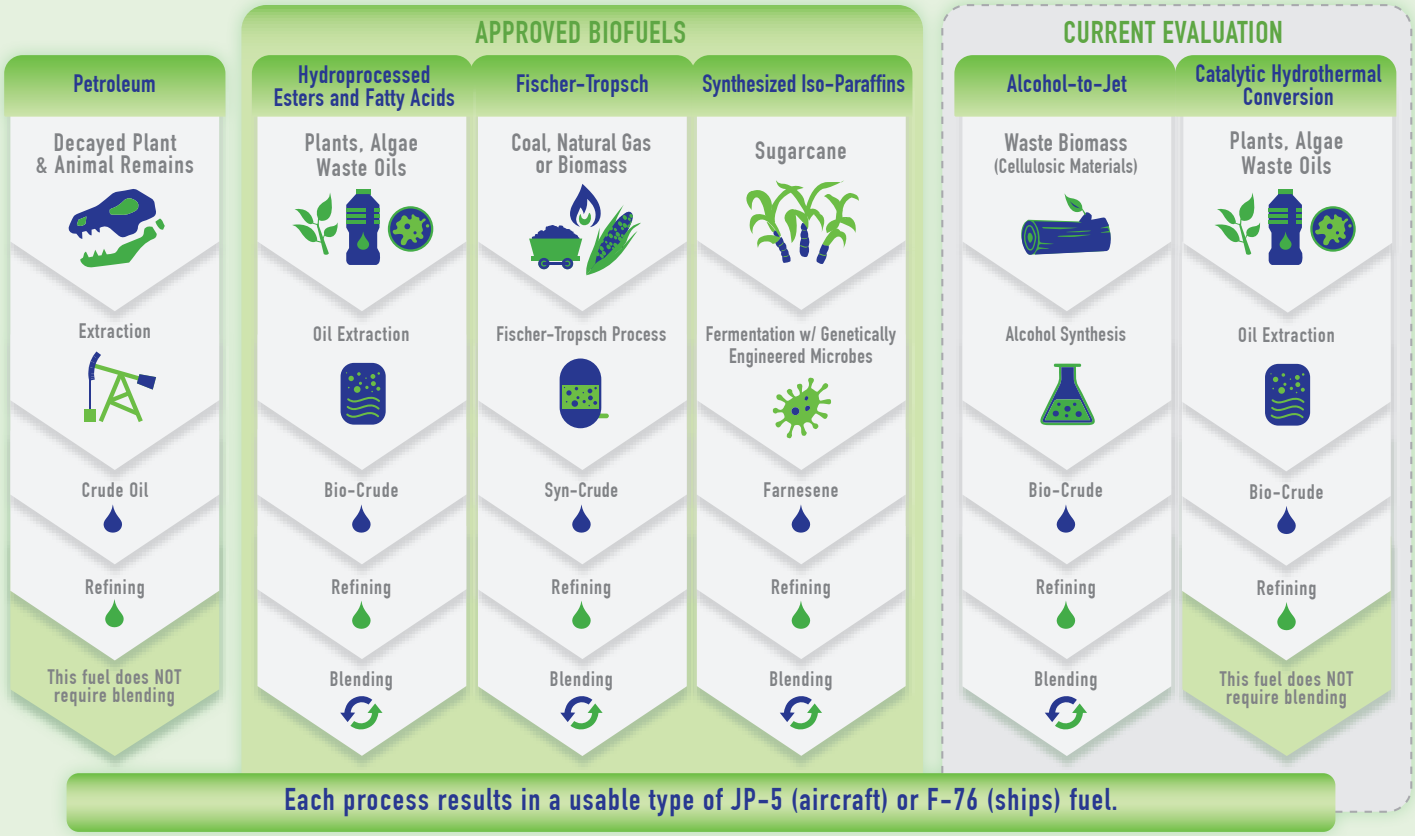
"The sources of the fuel can change, but not the fuel itself," Kamin said.

The fuels team has evaluated five alternative sources for JP-5 and four F-76 ship diesel sources since SECNAV kicked-off the program in 2009. *(See graphic on page 19.)* The team, however, was already

Advanced Biofuel Production Processes

As part of its qualifications program, the fuels team evaluated five alternative sources for JP-5 and four F-76 sources since SECNAV kicked-off the program in 2009.

The biofuels were analyzed in the fuels lab and engine components were tested followed by aircraft ground and flight testing, with the ultimate goal of incorporating advanced biofuels into the military specifications.



Graphic created by Melissa A. Johnson

Source: NAVAIR Fuels Team

"We didn't just fill up the jet and fly it," said Assistant Secretary for Energy, Installations and Environment Dennis McGinn. "We did an extensive amount of ground testing, a lot of measurements at every point along that jet engine, from going into the fuel tank to coming out the exhaust. It was done well, and we're very confident that the 100-percent alternative works."

researching biofuels in response to interest from the U.S. Air Force and the commercial airline industry in 2008.

"We shot for this 100-percent drop-in fuel from the beginning," Kamin said. "We wanted to know if a fully synthetic JP-5 from a non-petroleum source could work in our systems and we proved that it could!"

Assistant Secretary for Energy, Installations and Environment Dennis McGinn recognizes the fuels team's due diligence.

"We didn't just fill up the jet and fly it," McGinn said of the Navy's involvement over several years now. "We did an extensive amount of ground testing, a lot of measurements at every point along that jet engine, from going into the fuel tank to coming out the exhaust. It was done well, and we're very confident that the 100-percent alternative works."

Benefits of Alternative Fuels

"This is a continuation of a long Navy tradition," Mabus said. "In the middle of the 19th century, we went from sail to coal. In the early 20th century, we moved from coal to oil. In the mid-20th century, we pioneered nuclear as a propulsion method. Every single time we moved to a new form of power, as we are doing now with alternative fuel, people had doubts; and every single time they were wrong."

A 100-percent alternative helps with procurement and logistics, Kamin said. A blend requires the biofuel manufacturer to blend its biofuel with a petroleum-based

U.S. Navy photo by Adam Skoczylas

Lt. Cmdr. Bradley Fairfax, test pilot with Air Test and Evaluation Squadron (VX) 23, after completing ground testing Sept. 30.

Test Pilot Perspective

"There are several differences between test flying and fleet flying," said Lt. Cmdr. Bradley Fairfax.

"First, flight test, especially propulsion testing, involves flying the aircraft to very exact flight conditions and collecting data via scripted maneuvers. By doing this around the edges of the flight envelope, we can evaluate the performance of the aircraft in worst-case scenarios, and feel confident that fleet aviators will have satisfactory performance when they employ the aircraft in combat.

Second, executing the scripted maneuvers usually involves flying the aircraft in non-standard or new configurations. For the biofuel testing specifically, we only performed the throttle transients on one engine at a time, but the engines are designed to be used as a single propulsion system. We also secured auxiliary systems, like bleed air circuits and generators, that are normally left operating for fleet flights."

U.S. Navy photo by Adam Skoczylas

The afterburner lights during single and double-engine tests conducted Aug. 30 at Naval Air Warfare Center Aircraft Division's Aircraft Test and Evaluation Facility.

JP-5 to produce an on-specification product, which requires more time and additional facilities, all with a higher cost.

"Having our platforms certified to operate on 100-percent alternative fuels gives us flexibility and, in the end, gives us both a strategic and combat advantage," Mabus said. "It gives us options; options which are important now and will remain important in the future."

And the Navy is not alone.

"The commercial sector is also working hard to incorporate alternative fuels into their supply chains, which will only increase our operational flexibility," Mabus said.

The Navy fuels team is collaborating with commercial activities such as the American Society for Testing and Materials (ASTM), the owner of commercial fuel specifications, and the Commercial Aviation Alternative Fuels Initiative (CAAFI), which seeks to enhance energy security and environmental sustainability for aviation through jet fuel produced from alternatives to petroleum, Kamin said.

For example, General Electric, which makes the engines for the F/A-18, also makes engines for commercial aircraft. "It's a big community of military and commercial activities sharing information and working together to make sure that everyone has what they need to allow qualification to proceed," Kamin said. "We, the Navy, are a customer and our role is to qualify processes that we can use, regardless of where the fuel source originated."

The fuels team will continue to look at safety and interoperability with the commercial airline industry, Kamin said. "We'll look at opportunities to qualify processes for the Navy in the future," he added. "This is the way of doing business in the future as multiple sources are qualified, and as the demand increases, competition should bring the costs down."

Kamin points out that, like any new product in the early stages of development, it takes time for markets to develop and the industry to be built and grow. Take the cell phone, for example. The first handheld cellphone, Motorola's DynaTAC 8000X, cost $3,995 in 1984, and despite the cost, it became a business necessity with demand exceeding expectations.

"Look at where we were six years ago; we only knew how to use petroleum. Now we know how to use many other sources to make our ship and aviation fuel. More importantly, we set the benchmark and the strategy is in place to look at alternatives in the future," Kamin said.

The 100-percent alternative biofuel is also good for the environment, said Andy McDaniel, fuels engineer with NAVAIR's fuels and lubricants department and project engineer for the F-76 ship engine testing.

"One notable difference between CHCJ and petroleum-derived fuels is the absence of trace-contaminants and sulfur compounds," McDaniel said. "The sulfur, nitrogen and oxygen-based compounds which naturally exist in fossil fuels are not present

U.S. Navy photo by Sarah Ehman

Flight test engineer and project lead Mary Picard monitors a test flight from Naval Air Warfare Center Aircraft Division's Real-time Telemetry Processing System at the Atlantic Test Ranges.

in the biological feedstock. Thus, you don't see them in the final finished product."

Test and Evaluation

After SECNAV announced his five aggressive energy goals in 2009, biofuels testing became a priority for the fuels program with the first test flight targeted for Earth Day 2010.

"We had a very ambitious timeline," said Kamin. "From the receipt of the fuel, we completed initial testing of the HEFA 50/50 biofuel blend to allow flight testing in less than six months."

On April 22, 2010, the "Green Hornet" demonstration flight at Pax River was one of 16 test flights conducted on a F/A-18F Super Hornet that evaluated the performance of the biofuel blend across the entire aircraft flight envelope—the range of altitude and airspeed in which the aircraft is permitted to operate.

Kamin describes the qualifications program as the evaluation of many paths to one product—JP-5 jet fuel.

The first and most important step was to develop and validate standard test and qualification protocols for JP-5 and F-76 in the form of a standard work package.

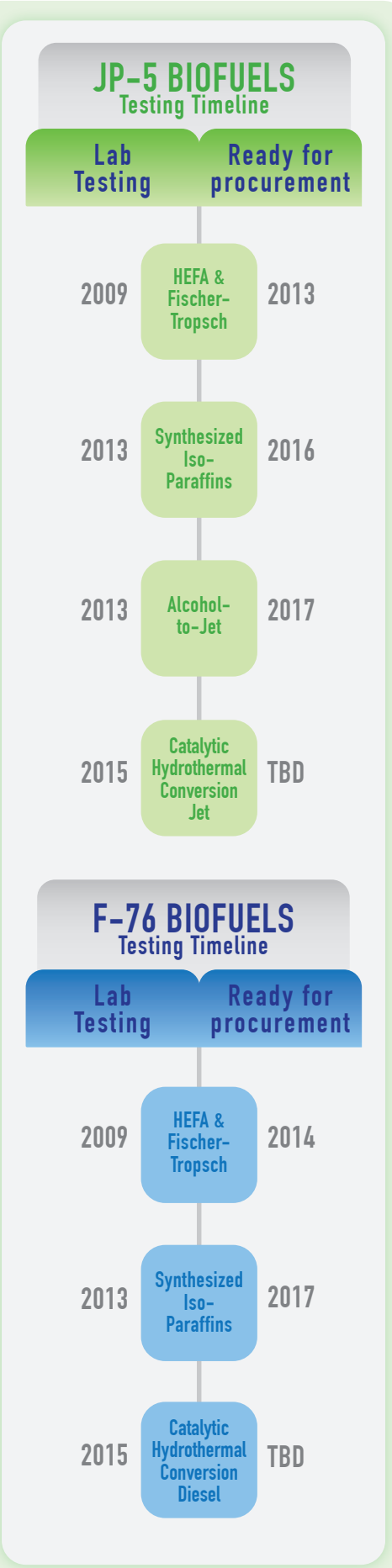
"The heavy lifting was done six years ago when the fuels team developed the test protocols," said Jennifer Rasmussen, a project engineer for the JP-5 biofuels program.

"Not only do we analyze the results, but we take what we learned every time we do a new fuels program and turn it into a better program," McDaniel said. "We are always looking to optimize what we do for testing, whether it's using fewer resources or getting better technical information."

Testing begins with NAVAIR's fuels and lubricants laboratory conducting a two-part process: evaluating performance to specification standards, and then analyzing 'fit-for-purpose' tests, Kamin said.

Fit-for-purpose testing involves 20 to 30 tests that analyze properties and chemistries outside the specification.

"We have to make sure the JP-5 produced from renewable sources has the same properties we have come to expect of petroleum-based fuels," Kamin said. For example, the dielectric constant of the biofuel is important for tank gauging on the F-18; if the dielectric constant of the bio-based fuel is not the same as petroleum-based jet fuel, the F/A-18's tank



Graphic created by Melissa A. Johnson

U.S. Navy photo by Adam Skoczylas

Geoff Eldridge, chemist in NAVAIR's fuels and lubricants department, demonstrates a fuel viscosity test, which measures the fuel's level of thickness and flow.

U.S. Navy photo by Adam Skoczylas

Chemists at the Naval Research Laboratory evaluate fire safety of biofuel alternatives by exposing the fuels to multiple extinguishment agents.

Collaborative Effort

The technical fuels community is small but effective, sharing resources and information across the Navy, with other services and with the commercial airline industry.

"One of the government's best kept secrets is the interagency cooperation among the Naval Fuels and Lubricants Cross Functional Team," said Rick Kamin, energy and fuels lead for Naval Air Systems Command (NAVAIR). Kamin also leads the alternative fuel test and qualification program for the Navy.

The Naval Fuels and Lubricants Cross Functional Team is comprised of technical experts from across naval services, including the Naval Air Systems Command, Naval Research Laboratory (NRL), Naval Supply Systems Command Energy, the Naval Sea Systems Command, the Military Sealift Command, Marine Corps and the Coast Guard. The team's mission is to provide a single source of fuels-related technical expertise, guidance and solutions to all levels.

Additionally, NAVAIR works with its counterparts in the Air Force, Army and Defense Logistics Agency as well our allies, original equipment manufacturers and industry.

As the technical authority, NAVAIR operates the Navy's lead Fuels and Lubricants Laboratory, but relies on its in-house engineering expertise in propulsion, flight test, materials and airframes to evaluate the effect of biofuels on the aircraft in flight, Kamin said.

As a NAVAIR fuels engineer and project engineer for F-76 fuel ship engine testing, Andy McDaniel has witnessed the powerful technical collaboration this program has fostered. "The knowledge sharing from such a variety of specialists and decision makers has been fascinating, and has strengthened everyone's technical understanding of fuels as well as the systems they affect."

"It's been amazing watching the technical community get a stronger sense of what the information is telling them about their systems, and how that's driving us to higher levels of confidence and better methods for testing and analysis," McDaniel said. *—Andrea Watters*

gauging systems will provide incorrect fuel quantity readings to the pilot.

Other properties evaluated include fire safety, by exposing the fuels to multiple extinguishment agents to evaluate any changes; toxicology, to evaluate propensity of the fuels to have deleterious health effects such as carcinogenic properties, skin irritation, etc., and material compatibility, McDaniel said.

Material compatibility looks at what happens when the fuel comes in contact with a subset of materials found in the Navy and Marine Corps environment, such as silicon, rubber, metals and plastics. Specific tests look at seal swell of an o-ring to avoid causing leaks, weakening of materials and increased rates of corrosion, McDaniel said.

"Once no adverse material reactions are observed, the engine hardware is tested," Rasmussen said.

Rasmussen works with the original equipment manufacturers as they conduct component, rig and full engine tests at their facilities, and coordinates the technical review of test results, which involves propulsion and power engineers with expertise in areas such as performance, combustion, controls, engine design, auxiliary power units (APUs) and fuel systems.

For the 100-percent biofuel tests, Rasmussen coordinated with General Electric, manufacturer of the F-414-400 engine in the F/A-18E/F Super Hornet and EA-18G Growler; Rolls Royce, builder of the AE1107 engine in the V-22 Osprey; and Honeywell, the manufacturer of multiple APUs.

"We start with component tests such as atomization testing and wet rig testing, move into combustor rig testing, and finally to engine testing," she said.

The atomization tests, for example, measure the size and shape of droplets when sprayed to ensure they behave the same as JP-5.

"When we ignite a fuel in the combustor it needs to atomize very similarly to JP-5, meaning that it has similar droplet and spray patterns. We measured droplet diameters, among other parameters, and confirmed the spray patterns for JP-5 and

U.S. Navy photo by Steven Kays

Andy McDaniel, project engineer for the F-76 ship engine testing, discusses testing protocols for the F-76 marine and JP-5 aviation 100-percent advanced biofuel in NAVAIR's fuels and lubricants department.

CHCJ looked the same. That gave us a lot of confidence that the two fuels are going to atomize very similarly," Rasmussen said.

The fuel is then tested in a combuster rig by igniting it to compare its burn profile and temperature patterns, then in an engine to ensure the performance is adequate. In the lean blow out rate test, for example, the amount of fuel is reduced until the flame within the combustor goes out. The fuel being tested must perform similarly or better than JP-5, Rasmussen said.

"Once all the data comes back and the technical community is confident that the results confirm there is no impact from the fuel, then we move into flight test," Rasmussen said.

Flight Test

Flight test evaluates whether the aircraft system operates as expected throughout the flight envelope on a nonpetroleum-based JP-5 fuel.

"We are looking to make sure the engine operates properly on the biofuel and that it doesn't affect engine operation in any way," said Picard.

Picard develops the test plans and coordinates the test and evaluation at Naval Air Warfare Center Aircraft Division facilities at Pax River. She works closely with her military counterpart, Lt. Cmdr. Fairfax, and VX-23, which owns the EA-18G used in testing.

Fairfax was also a test pilot for the 50/50 blends of Alcohol-to-Jet and Synthetic IsoParaffins in 2014-2015. While Fairfax flies the EA-18G with test points on his kneeboard, Picard monitors the ground and flight tests at RTPS. She then analyzes the data and writes the report on how the biofuel performed.

Picard has been involved in the flight test of the biofuels program since 2010 and led the effort for the first biofuel testing of the Legacy Hornet in 2010.

"When we first started we had no idea what to expect. The engineers on the fuels side told us it was going to be exactly the same as JP-5, but until you go out there and give it a try, you are never completely sure," she said.

"Since the HEFA 50-percent blend was the first biofuel tested, we evaluated more test points," Picard said. "In the last

JP-5 BIOFUELS
Platform Testing

HEFA & Fischer-Tropsch 2010-12

F/A-18 E/F Super Hornet, F/A-18 A-D Hornet, MH-60S Seahawk, MV-22B Osprey, T-45 Goshawk, Blue Angel F/A-18 A-D Hornet, EA-6B Prowler, AV-8B Harrier, & MQ-8B Fire Scout

Synthesized Iso-Paraffins 2014

F/A-18 E/F Super Hornet
MV-22B Osprey

Alcohol-to-Jet 2015

F/A-18 E/F Super Hornet
MV-22B Osprey

Catalytic Hydrothermal Conversion Jet 2016

F/A-18 E/F Super Hornet
MV-22B Osprey

F-76 BIOFUELS
Platform Testing

HEFA & Fischer-Tropsch 2010-12

Rigid-Hulled Inflatable Boat (7-m)
Riverine Command Boat Experimental (RCB-X)
T/S State of Michigan
partnership with MARAD
Yard Patrol Boat (YP)
partnership U.S. Naval Academy
Self Defense Test Ship
MAERSK Kalmar
partnership with MAERSK
USS Ford (FFG 54)
Landing Craft Air Cushion (LCAC)
USCG Cutter Henry Blake
partnership with USCG

Synthesized Iso-Paraffins 2015-16

Rigid-Hulled Inflatable Boat (7-m)
Self Defense Test Ship

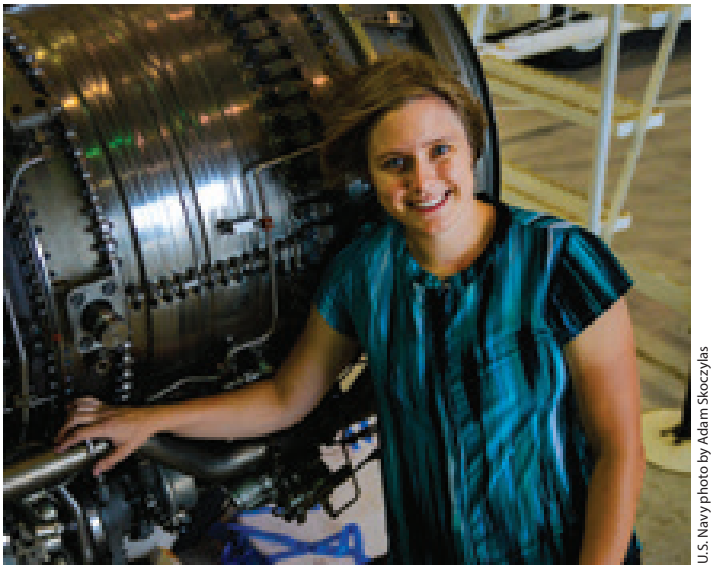
Catalytic Hydrothermal Conversion Diesel 2016

Rigid-Hulled Inflatable Boat (7-m)
Self Defense Test Ship

Graphic created by Melissa A. Johnson

U.S. Navy photo by Adam Skoczylas

Immediately following take-off, the EA-18G Growler on 100-percent alternative biofuel continues in afterburner.



U.S. Navy photo by Adam Skoczylas

As project engineer for the JP-5 biofuels program, Jennifer Rasmussen works with the original equipment manufacturers as they conduct component, rig and full engine tests at their facilities, and coordinates the technical review of test results.

several years, we have developed historical knowledge of biofuels, and reduced the number of test points on the blends. The test matrix, however, was expanded slightly since this fuel is a 100-percent biofuel," she said.

In-flight, the flight test team added a higher altitude subsonic functional check and an additional supersonic functional check along with a few more airstarts to more thoroughly investigate the operation of the engine throughout the flight envelope, Picard said.

Flight test starts on the ground, and the 100-percent alternative fuel was no exception. In fact, an additional test—an acoustic ground test—was required, Picard said.

"When GE conducted the test originally the baseline with JP-5 was performed on a warmer day than the testing with CHCJ. The results showed, after taking temperature into account, that the CHCJ had higher vibration levels or 'rumble,'" she said.

"To address that, the NAVAIR fuels team requested we perform the test installed in the aircraft on similar temperature days to reduce that variable. We conducted the baseline JP-5 test and CHCJ tests on similar temperature days

Great Green Fleet Demo

The Rim of the Pacific (RIMPAC) 2012 Great Green Fleet trial provided operational validation of the laboratory, test stand and controlled platform test results conducted by the Navy's alternative fuel qualification program.

The unanimous opinion from the shore facility, ship and aircraft personnel was that the 50-percent bio-based JP-5 and F-76 was operationally similar to the petroleum-based JP-5 and F-76 used both prior to and after the biofuel testing.

During the Great Green Fleet RIMPAC 2016, the Navy used 11.2 million gallons of a 10-percent alternative fuel blend of beef tallow mixed with marine diesel.

"We're at a 10-percent blend now, depending on price and availability," said Dennis McGinn, assistant secretary for energy, installations and environment. "Then we'll start seeing blends for marine fuel and jet fuel at 20 percent biofuel, 30 percent, as we continue building up."

and observed there was not a significant difference in vibration levels between the two fuels," she said.

"We try to wring out the engine and the control system on the ground by doing several throttle transients similar to the ones we do in flight. Once we get up in altitude things are going to change, but we check it out on the ground, making sure everything looks good. Once we are happy with the results, then we can proceed with flight test," she said.

"In-flight, we will perform a series of throttle transients, where we move the throttle to and from specific power settings in order to stress a particular limit of the engine," she said.

For example, throttle chops from a mid-power range to idle power can use up some of the flameout margin the engine has built in, she explained. "If all of the margin is used, then the combustor will flameout. We test this to ensure the CHCJ does not have a greater effect on flameout margin than we expect."

After six days of flight test, CHCJ 100-percent biofuel demonstrated that it is indeed a drop-in replacement, Picard said.

Updating Military Fuel Specifications

The final step in qualifying a drop-in replacement is the incorporation of the alternative in the standardized military specifications for both JP-5 in aircraft and F-76 in ships, Kamin said.

The specification change is the culmination of all the testing efforts, McDaniel said. "At that point, all Navy stakeholders have reviewed test data and agreed that the fuel is fit for use in naval operations."

The fuels team anticipates completing the qualification for the 100-percent alternative in the first quarter of fiscal year 2017.

"We've demonstrated that we have developed the protocols to evaluate multiple alternatives and that we have the team to do it," Kamin said.

Andrea Watters is the editor of Naval Aviation News and a public affairs specialist with Naval Air Systems Command.

U.S. Navy photo by MC2 Timothy M. Black

Powered by 100-percent advanced biofuel, the Self-Defense Test Ship is underway off the southern coast of California.

Shipboard: Navy Tests Diesel F-76 100-Percent Renewable Fuel

The U.S. Navy has more than 100 different diesel engine makes and models in its inventory along with gas turbine engines and boilers, all of which run on F-76 diesel fuel.

A program similar to the one used to evaluate aviation JP-5 fuel alternatives is also designed and used to qualify diesel F-76 fuel alternatives, which serves as a primary fuel for maritime vessels, said Andy McDaniel, fuels engineer with the Naval Air Systems Command's (NAVAIR) Fuels Team. NAVAIR manages the Navy's alternative fuels test and qualification program.

McDaniel has worked with all of the alternative fuels tested since SECNAV established his energy goals in 2009, and is currently the project engineer for the 100-percent advanced biofuel—catalytic hydrothermolysis conversion to diesel (CHCD) qualification. CHCD was developed by Applied Research Associates (ARA) and Chevron Lummus Global, as a drop-in replacement for petroleum-based F-76 marine diesel.

"We work closely with industry experts, Navy subject matter experts within the Naval Surface Warfare Command and the United States Naval Academy, and the technical warrant holders at the Naval Sea Systems Command to ensure the tests we conduct meet technical expectations," McDaniel said.

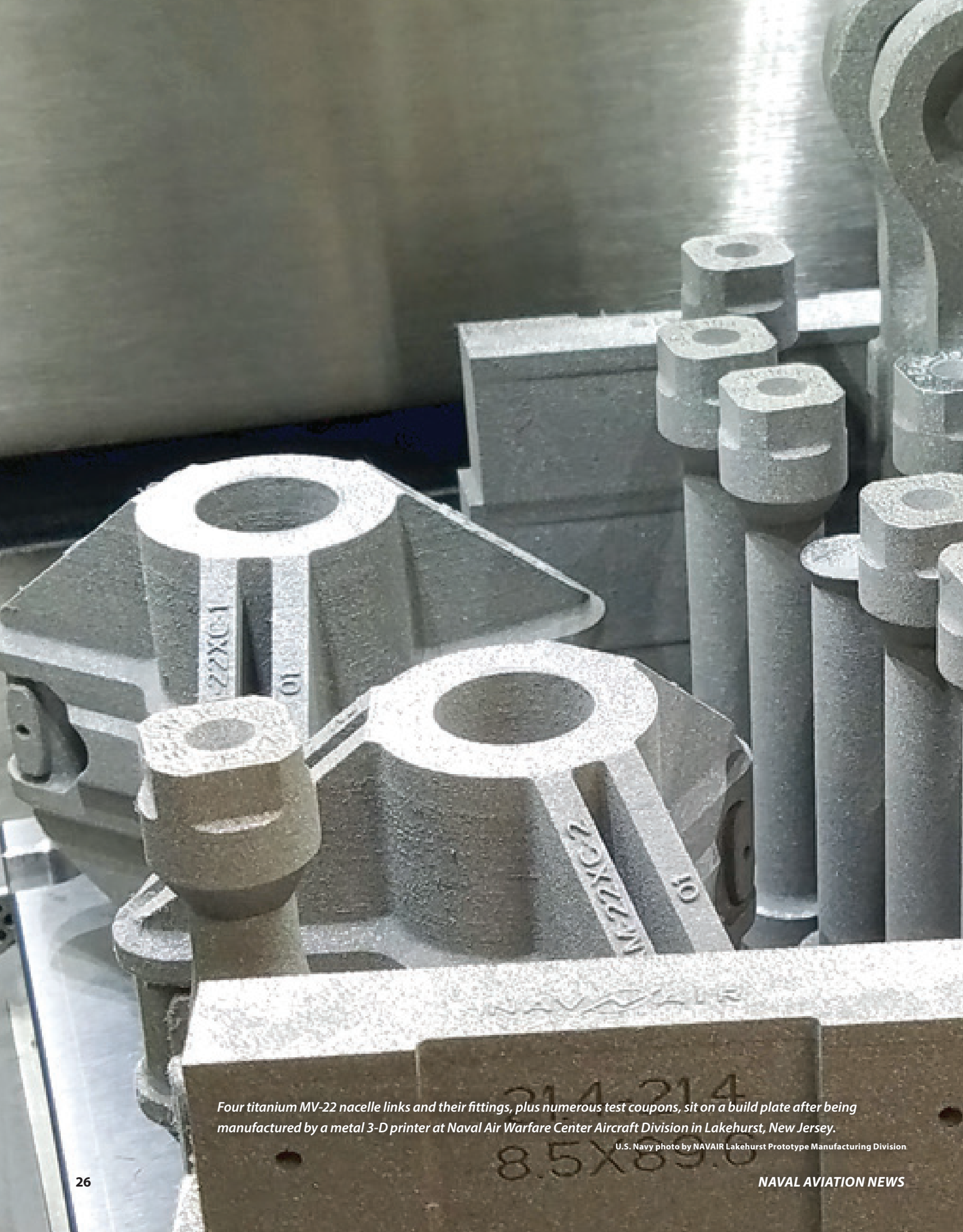
Like JP-5 alternatives, the F-76 fuels produced from alternative sources must also be invisible to the user, McDaniel said. And while the qualification protocols for F-76 alternatives are similar to those of JP-5, they place a greater testing emphasis on diesel and marine gas-turbine engines, he said. "We have a lot of ground to cover since there are so many types of hardware that use F-76."

After the boiler, gas-turbine, diesel engine test results confirmed that the CHCD performed similarly to conventional F-76, successful shipboard trials were conducted in June aboard the ex-Paul F. Foster, now the Self Defense Test Ship.

Navy engineers monitored the performance of the gas-turbine engines and generators while running on petroleum F-76 prior to taking on the CHCD to establish a baseline for comparison, McDaniel said.

"While operating on 100-percent biofuel, the ship successfully completed multiple engine starts and speed changes, and there were no mechanical, operational or qualitative differences during operations," he said.

NAVAIR and the Navy's fuels team continue to look at ways to improve data sets and conduct testing more efficiently, McDaniel said, "whether it's extracting more information from the tests we currently run or refining the quantity and types of tests conducted as we continue to learn."—*Andrea Watters*



Four titanium MV-22 nacelle links and their fittings, plus numerous test coupons, sit on a build plate after being manufactured by a metal 3-D printer at Naval Air Warfare Center Aircraft Division in Lakehurst, New Jersey.

U.S. Navy photo by NAVAIR Lakehurst Prototype Manufacturing Division

Printing the Future:

Additive Manufacturing Promises to Boost Naval Aviation Readiness

by Jeff Newman

At a time when the U.S. Navy and Marine Corps are stretching aircraft beyond their intended service lives to meet training and operational needs, a revolutionary technology that could forever change the way the nation's military maintains its platforms signaled its hastening maturity July 29 with a first-of-its-kind flight demonstration.

A team of engineers assembled nearby gave a hearty cheer when the MV-22B Osprey successfully lifted off and hovered above its airstrip at Patuxent River Naval Air Station, Maryland, before tilting its rotors forward and zooming off—a culmination of 18 months of work to safely outfit and fly an aircraft for the first time with a flight-critical part made using additive manufacturing techniques.

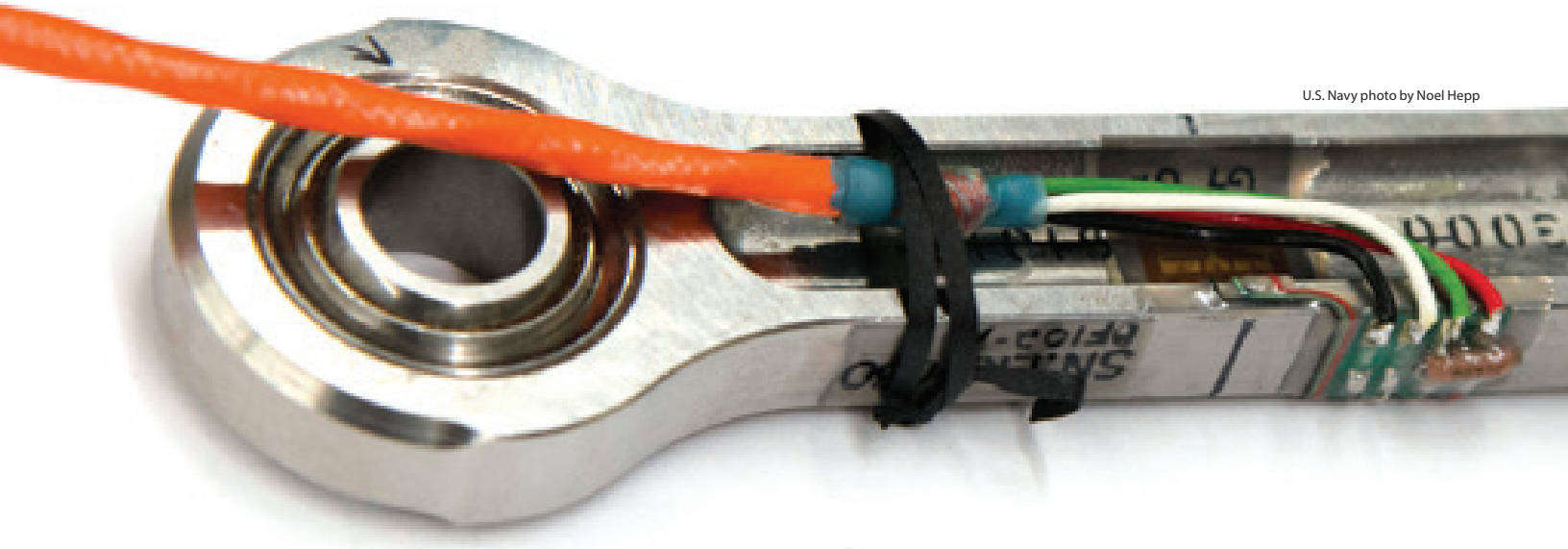
Equipped with a titanium, 3-D printed link and fitting assembly in one of its engine nacelles, the Osprey completed its standard flight performance envelope before landing safely less than an hour after taking off.

"The flight went great. I never would have known that we had anything different onboard," said MV-22 project officer Maj. Travis Stephenson, who piloted the flight.

A technology that has existed since the early 1980s but undergone rapid development in recent years, additive manufacturing refers to the process of using 3-D printers to build objects in layers using one or more materials—such as plastic polymers or metallic powders—as opposed to traditional "subtractive" manufacturing, where bulk materials are cut or machined down into the desired object.

Using digital model-based data, 3-D printers are able to create in minutes and hours objects that, using traditional methods, would normally take days or weeks. The potential for cost- and time-savings as well as innovation are immense regardless of industry, and the military is no exception.

Which is why Naval Air Systems Command (NAVAIR) developed an additive manufacturing roadmap in September 2014, with one of its goals to fly a flight-critical part—meaning one deemed essential to maintaining safe flight—within three years.



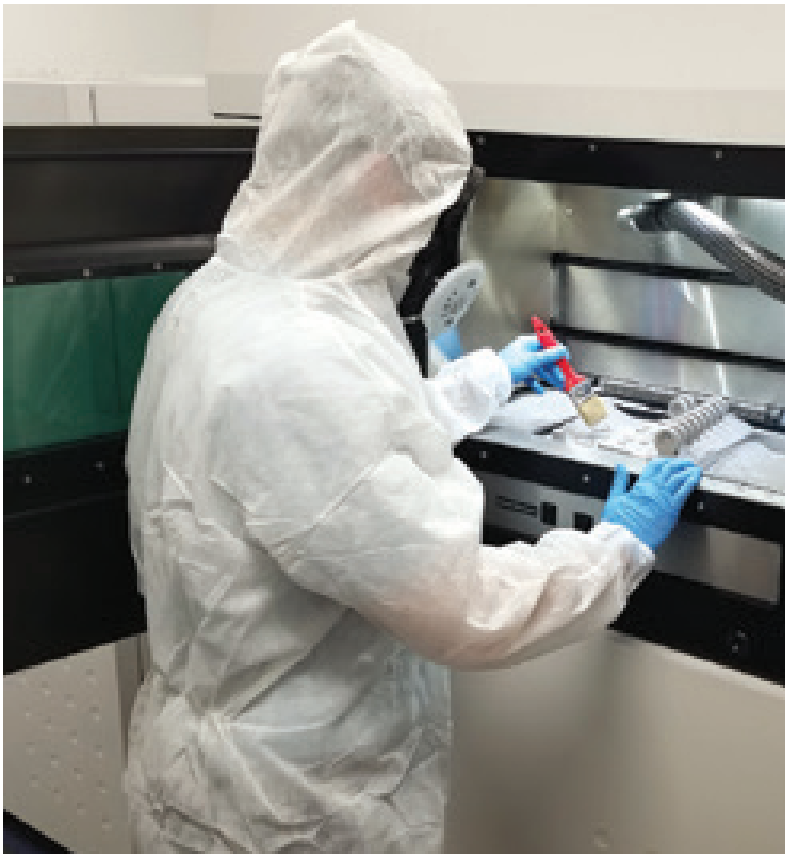
U.S. Navy photo by Noel Hepp

> *"As difficult as it was to produce the part, McMichael said her team found it just as challenging 'culturally' to convince test engineers that a 3-D printed part could be just as strong and dependable as its traditionally manufactured version. But after the part was printed at Naval Air Warfare Center Aircraft Division in Lakehurst, New Jersey, it proved in component testing to be just as sturdy, and in some areas more so, than the original link and fitting."*

"We did it in 18 months," said Liz McMichael, NAVAIR's additive manufacturing and digital thread integrated product team lead. "That's not something from my experience that happens very often."

McMichael called the test "a validation that happened faster than we honestly thought [was possible] going into it."

"We were able to go in and make four different production designs of this additive manufacturing part in a very few months," McMichael said. "That's the equivalent of multiple production line stand-ups, and if we did that in a traditional way, it would have taken years, so just being able to change how we do things has really shown us that this technology is



U.S. Navy photo by NAVAIR Lakehurst Prototype Manufacturing Division

The 3-D printed titanium link was fitted with instrumentation prior to being installed on the MV-22 in preparation for the July 29 demonstration flight at Naval Air Station Patuxent River, Md.

going to be usable. We think we are starting to understand the processes that we need to do to use it safely."

"NAVAIR and the Navy have been at the pointy edge of the spear. We recognize the potential of additive manufacturing to address operational availability, enhance performance and reduce cost, and so our role has been to be the technical and programmatic lead for the Department of Defense," said Bill Frasier, NAVAIR's chief scientist for air vehicle engineering and the Navy's senior scientist for materials engineering. "Not bragging or anything, but we have been recognized as taking the lead on that. We are breaking new ground and it is going to have a very positive effect on us in the future."

Naval Air Systems Command civilian engineer Kyle Cobb unpacks a set of MV-22 nacelle links and fittings from a metal printer at Naval Air Warfare Center Aircraft Division in Lakehurst, N.J.

Proving It Safe

In deciding which parts to begin printing, McMichael said her team settled on the V-22 link and fitting, one of four that secures each nacelle to its wing, for a couple reasons—the part is titanium, one of the more mature manufacturing materials, and installed in a failsafe configuration where if the 3-D printed link broke, the other three would keep the engine fastened to the wing.

After selecting the part, McMichael's team approached the MV-22B test program about using the Osprey as the first platform to demonstrate the viability of using additive manufacturing to produce flight-critical aircraft parts.

"We took a look at that, what their proposal was and felt like it was absolutely something we could support," said Ray Dagenhart, lead test engineer for the MV-22B test program. "It's not a new part. It is obviously a legacy part that we have instrumented and flown for years and very much know the history of. The additive manufacturing team took a look at that and chose this part for that reason, as well as it being a redundant link."

As difficult as it was to produce the part, McMichael said her team found it just as challenging "culturally" to convince test engineers that a 3-D printed part could be just as strong and dependable as its traditionally manufactured version. But after the part was printed at Naval Air Warfare Center Aircraft Division (NAWCAD) in Lakehurst, New Jersey, it proved in component testing to be just as sturdy, and in some areas more so, than the original link and fitting.

"One of the big points of this demonstration was to establish that this can be done, to showcase that printing a flight-critical part is possible," said Eric Kline, NAVAIR's prototype manufacturing lead for additive manufacturing. "What that does is it sends a strong message to the whole organization that if we can print a flight-critical structural part, then we can do those less-critical items knowing that this process is sound."

McMichael said her team will continue working with the V-22 program to incorporate the 3-D printed link and fitting as a formal configuration change for the aircraft.

In addition to the link and fitting, McMichael's team has identified five other flight-critical parts it hopes to print and fly in the coming year, all for Marine rotorcraft—a stainless steel lever for the V-22's fire extinguishing system, titanium Clevis and lug latches for the CH-53K King Stallion heavy-lift helicopter, and stainless steel uniball suppressor support and engine mount fitting for H-1 helicopters.

Cutting the Logistics Chain

The Navy has used 3-D printers to rapidly make prototypes since the early 1990s, and in recent years has been printing non-safety critical parts and tools with increasing frequency. In June 2014, technicians at NAVAIR's Fleet Readiness Center (FRC) East, located at Marine Corps Air Station Cherry Point, North Carolina, used 3-D printed tools to make and deliver replacement parts seven days after an AV-8B Harrier damaged its nose cone following a hard landing on USS Bataan (LHD 5). Last year, maintainers at FRC Southeast in Jacksonville, Florida, saved invaluable time repairing a P-8 Poseidon's wheel-well truss when

NAVAIR civilian engineer Kyle Cobb brushes away loose powder from a 3-D printed build plate consisting of four MV-22 nacelle links, fittings and test coupons. After the build plate is completed, it is covered in unfused powder which must be brushed and vacuumed away. The excess powder is collected and then reused in subsequent builds.

Aviation mechanic Cody Schwarz installs a 3-D printed titanium link and fitting inside an MV-22 Osprey engine nacelle July 28 at Patuxent River Naval Air Station, Md. Schwarz can be seen holding the link prior to affixing it to the aircraft.

> **"Regardless of whether 3-D printers are ever able to match Starfleet's replicators, additive manufacturing promises to transform the Navy's ability to sustain and repair its aircraft, as well as design and field new platforms, weapons and sensors."**

they 3-D printed a prototype of a repair fitting and discovered flaws ahead of its delivery by Lockheed Martin.

But following the July 29 demonstration, Navy officials foresee a future where fleet maintainers as well as industry partners can print any part, safety-critical or not, on demand.

"Initially our real goal is to make sure we understand the manufacturing processes and we can ensure that when we put an additive manufacturing part on our aircrafts, particularly metal parts, that we know how it is going to perform," NAVAIR Commander Vice Adm. Paul Grosklags said. "We need to have quality control processes and standards that we can implement for ourselves and our industry partners if they are manufacturing it. Much like any other part that we put on an aircraft, we must understand how it will perform."

Ultimately, the goal is to have ships deploy with 3-D printers onboard, ready to print parts as needed from stores of composite materials, cutting down on the need to keep large reserves of commonly-needed parts, and removing from the logistics chain the timely process of flying parts manufactured on traditional land-based production lines out to sea.

Amphibious assault ship USS Essex became the first Navy vessel to have a 3-D printer installed onboard in 2014, and its Sailors have used the machine to print a variety of basic items, such as oil reservoir caps, deck drain covers and medical supplies.

USS Harry S. Truman (CVN 75) and amphibious assault ship USS Kearsarge (LHD 3) deployed with 3-D printers last year, and the

U.S. Navy photo by Noel Hepp

An MV-22B Osprey equipped with a 3-D printed titanium link and fitting inside its engine nacelle maintains a hover as part of a July 29 demonstration at Patuxent River Naval Air Station, Md. The flight marked NAVAIR's first successful flight demonstration of a flight critical aircraft component built using additive manufacturing techniques.

the Truman made news this summer when the digital design file for the TruClip, a replacement radio clip produced by its Sailors, was sent to the International Space Station for its astronauts to use in their 3-D printer. Designed because the original radio clips were breaking frequently, each TruClip costs about 6 cents to produce, a roughly 10,000-percent savings on the $615 it previously cost to replace each clip.

Apply this to the world of aircraft maintenance, and replacement parts that typically take months or even years to procure could theoretically be printed overnight and readied for installation in a matter of days.

"One of the opportunities that additive manufacturing has is just the rapid ability to make parts compared to other processes," said Greg Welsh, a NAVAIR materials engineer. "We have a lot of assets that are nearing the end of their life and obsolescence can be a problem. We have a lot of issues where we have a long lead time for parts or a diminishing supply base where it is hard to get parts. So additive manufacturing offers a way to, rather than waiting for sometimes over a year to get a part or qualifying a new vendor, to be able to print things much more quickly."

Using 3-D printers to make parts also removes the need for custom-designed repair tools, which can often take just as long if not longer to design and manufacture as the actual repair work takes to complete.

"We are really interested in additive manufacturing because you can produce parts that you need quickly and there is no tooling required for it," said Brandi Briggs, a mechanical engineer with the Nondestructive Inspection Branch of NAWCAD. "You use the same machine to produce lots of different parts, almost anything you can think of, and that makes it really different from traditional processes and allows us to reduce the time that our aircraft are down."

Printing the Future

Additive manufacturing also carries the promise of allowing engineers to come up with "novel design concepts" that they previously could not entertain, said John Schmelzle, additive manufacturing model-based definition lead at Lakehurst.

"In a traditional design, an engineer always has to think about how you're going to make it," he said. "We have to design for manufacturer ability, which is kind of a constraint on the design engineer. You'd love to be able to just make anything, but you can't. Additive manufacturing, it unleashes a lot of those constraints.

"I always like to say that in additive manufacturing, the real constraint becomes the limit of the engineer's imagination, as opposed to the constraints you have in traditional manufacturing, and to somebody who's very creative, that thought is kind of provocative, that you can do almost anything with it."

Speaking of imagination, Schmelzle didn't bother reeling his in while considering the potential additive manufacturing holds for the future.

"You look at the USS Enterprise and Jean Luc Picard," he began, referencing the famed "Star Trek" starship and space captain, "he goes up to his replicator and they ask for a part, and out comes the part, and I see that as a potential—maybe not tomorrow, maybe not in a few years—but maybe long term where we could just print out the parts instead of ordering them. Get rid of the entire logistics chain, and send electrons as opposed to sending parts."

Regardless of whether 3-D printers are ever able to match Starfleet's replicators, additive manufacturing promises to transform the Navy's ability to sustain and repair its aircraft, as well as design and field new platforms, weapons and sensors.

"If you look at our readiness posture and you look at what we need to do to accelerate, we need to improve not only how we get our airplanes back from the fleet and how we sustain them right now, but we need new capabilities out there faster, and additive manufacturing is a technology that enables that," McMichael said.

Being part of the first group to successfully demonstrate the viability of 3-D printed safety-critical parts has McMichael's team geared up to do more.

"To be able to open up new opportunities, it's really exciting getting involved in something like this right at the beginning, right at the forefront and being a part of the team that will help make decisions and shape where this technology will go and how it will be implemented in the Navy," Briggs said.

Jeff Newman is a staff writer and contributing editor to the Naval Aviation News magazine.

U.S. NAVAL AIR FORCE RESERVE

A Century of Service

Part II

By Cmdr. Peter B. Mersky, USNR (Ret.)

Photo courtesy of Robert Lawson

Author's Note: *Since the Navy and the Marine Corps have always been linked, it should come as no surprise that the two services' reserve air corps were founded at the same time. However, this commemorative two-part article focuses on the Naval Air Reserve established in 1916, later renamed the Naval Air Force Reserve.*

The Vietnam Era

As memories of World War II and the Korean War began fading, the nation's military reserves went their ways, settling into the peacetime they had fought so hard to establish. But the road was not smooth, and by the mid-1960s, another conflict in Asia would involve a reluctant America. After the heart-wrenching assassination of President Kennedy in November 1963, there was a time of uncertainty regarding America's resolve in foreign affairs. The Soviet Union and China were seeking to extend their communist dominion over the Third World, with troubling success. By the early 1960s, Southeast Asia had become a hotbed of bloody conflict. Vietnam had been divided at the 17th parallel, with the North sending men and supplies south to depose the rulers in the South. President Eisenhower sent American advisors to help the South, a limited role Kennedy initially maintained but was considering scaling back when he was killed.

His vice president and successor, Lyndon Johnson, found himself sending more U.S. troops and other units after a clouded sequence of attacks on U.S. ships in August 1964. Among the most busy Naval Air Reserve (NAR) squadrons were the transport units using R5Ds (C-54s/DC-4s) and R6Ds (C-118s/DC-6s) to move men and supplies—often totaling 15,000 pounds per plane—into South Vietnam.

NAR manpower came from individuals rather than whole squadrons. The number of pilots and crews required to man aircraft and ships and to run shore-based facilities rose rapidly, and the services' various pre-commissioning and flight-training programs shifted their production into high gear, with most of the graduates gaining Reserve commissions.

Thousands of young Americans were commissioned during the Vietnam War, through the Navy's Aviation Officer Candidate School (AOCS), established May 1955 in Pensacola, Florida, a primary source of new Reserve officers.

By the time AOCS was disestablished in 2007, it had graduated 55,000 Naval Reserve ensigns, the majority of whom went into aviation activities from pilot, NFO, air intelligence and other related billets.

USS Pueblo Brings Major Reorganization

Cruising off the North Korean coast, environmental research ship USS Pueblo (AGER-2) was captured and boarded by North Korean sailors Jan. 23, 1968, a seizure that set off a chain of events affecting the Reserves. Besides sending a fleet carrier task force up from the South China Sea into the Sea of Japan, extending an already lengthy deployment, President Johnson also recalled six NAR carrier A-4 and F-8 squadrons—72 aircraft and 593 selected reservists (SELRES)—to augment the squadrons already aboard the task force carriers.

For several years, reservists—now referred to as Reserve Component (RC) Sailors—had flown obsolescent aircraft and had to share the limited number with Marine Corps Air Reserve squadrons on the same field. Upgrading to

C-118s from Transport Squadron (VR) 772 made several supply runs from home base at Los Alamitos, Calif., to Chu Lai, South Vietnam in 1966.

U.S. Navy photo

These F-8H Crusaders are from Washington, D.C.-based Fighter Squadron (VF) 661.

Photo courtesy of JOSN J.W. Fletcher

Cmdr. Milton E. Johnson, Commanding Officer of Attack Squadron (VA) 776, taxying in after landing on January 30, 1968—five days after a recall order was issued during the Pueblo Crisis.

fleet-comparable models was slowing down squadrons as they readied themselves for integration into the fleet during a national crisis. The F-8 squadrons struggled at Naval Air Station (NAS) Jacksonville, Florida, as they tried to move to newer variants of the Crusader. By September, the diminished international situation and the problems with preparing the Reserve squadrons resulted in their release from active duty. It was a tough, embarrassing lesson for everyone concerned, and major changes to the overall NAR began.

The plan was to create a mirror image of the fleet. On April 1, 1970, two Reserve carrier air wings (CVWRs) were commissioned, CVWR-20 and CVWR-30, which would respectively deploy to the Atlantic Fleet and Pacific Fleet. Two short-lived wings were also commissioned for anti-submarine warfare (ASW) use, CVSGR-70 and CVSGR-80. Twelve maritime patrol (VP) and three transport (VR) squadrons were also part of the reorganization. It was an ambitious plan that included equipping the new squadrons with aircraft types that were also in the fleet.

The restructuring was hailed as a major milestone, and it certainly made the NAR a more modern and deployable force. It took advantage of many aircrews who, although they were leaving active duty following combat tours in Vietnam, did not want to hang up their uniforms and put their gold wings in a jewelry box.

Another advantage of the Reserve air wing was the entire wing would do its annual two-week active duty as a unit. Accordingly, squadrons of CVWR-30 went out to carrier USS Franklin D. Roosevelt (CVA 42) in late 1970 for carrier qualifications (CQs). Operations went smoothly, particularly because many squadron members had recently returned from Vietnam with considerable operational and combat experience in their aircraft. After CQs, the wings deployed to several sites such as the weapons training range at NAS Fallon, Nevada.

By the mid-1970s, Reserve air wing squadrons had received even more modern aircraft such as the F-4 Phantom II and A-7 Corsair II. An earlier attempt to include the F-4 in the Reserves at then-NAS Los Alamitos, California, in 1970 did not work out, and it was not until 1974 that the first F-4Bs joined Fighter Squadron (VF) 301 and VF-302 at NAS Miramar, California. The Marine Corps Air Reserve had also accepted its first F-4Bs, giving up its F-8s. Attack squadrons based in California at NAS Point Mugu, Lemoore and Alameda exchanged their A-4s for A-7s and, briefly, A-6s.

With new aircraft sporting colorful markings that recalled the 1930s, the NAR had finally begun to achieve a measure of parity with the fleet.

The apparent success was such that for a week in November 1976, CVWR-30 operated aboard USS Ranger (CV 61) as the ship's dedicated air wing. The success of this mini-deployment encouraged NAR wings

Photo courtesy of Peter B. Mersky

In 1970, one of Fighter Squadron (VF) 301's F-8Js is readied for launch from USS Franklin D. Roosevelt (CV 42) while a Light Photographic Squadron (VFP) 306 RF-8G is waved off overhead.

Photo courtesy of R.E. Kling

This S-2E Tracker from VS-82 is at NAS Jacksonville , Fla. as part of Carrier Anti-Submarine Air Group Reserve 80.

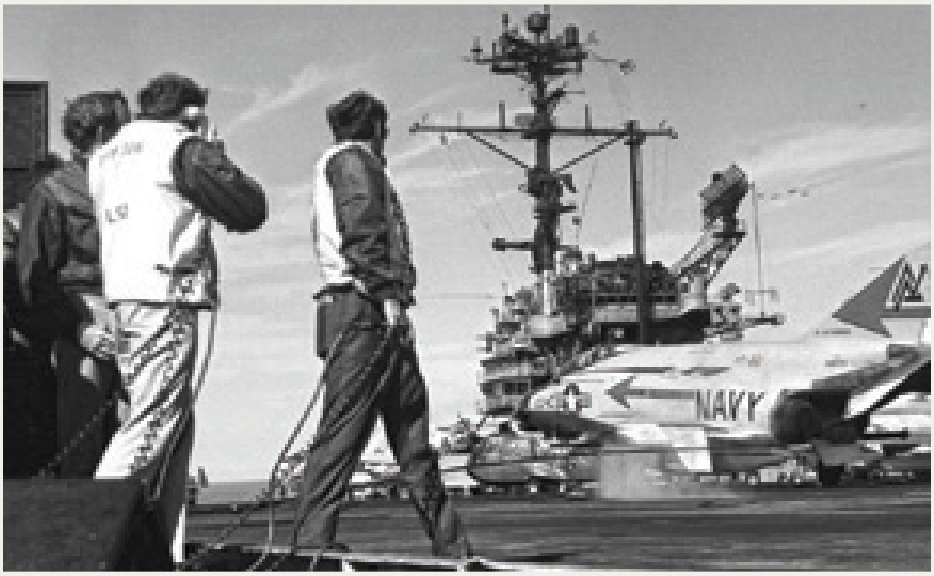


Photo by Peter B. Mersky

A VF-301 F-4N Phantom grabs an arresting wire, making a trap aboard USS Ranger (CV 61) in November 1976 during the TACAIR Test. The landing signal officers watch the trap closely.

to participate in various exercises and travel far from their home bases.

The remainder of the NAR—the maritime patrol (VP), helicopter (HS) and transport (VR) wings—also received updated equipment. The VPs had flown the veteran Lockheed P-2 Neptune but by November 1970 were transitioning to the much more advanced P-3 Orion. The HS squadrons were moving to the H-3 Sea King and H-2 Seasprite, while two unique helicopter attack units flying HH-1K Hueys were commissioned. Having enjoyed considerable success over a five-year period in South Vietnam, a lone helicopter attack squadron (light), HAL-3, would also develop into two HALS—HAL-4 at NAS Norfolk, Virginia, and HAL-5 at NAS Pt. Mugu, California. These two squadrons would be redesignated HCS-4 and HCS-5 and fly the Sikorsky HH-60H SAR-dedicated helicopter during Desert Storm in 1991 and remain an important search-and-rescue (SAR) asset into the 21st century. A single dedicated SAR squadron, HC-9, also appeared for a time equipped with the HH-3A, then the SH-3.

An important change occurred Jan. 1, 1973, when the surface—ships, submarines and shore-based activities—and aviation Reserves were brought together under one roof in a new, built-for-purpose complex in New Orleans, Louisiana. Previously, the surface Reserve had been administered by a two-star admiral based in Omaha, Nebraska, with the aviation side headquartered at NAS Glenview, near Chicago, central locations that supposedly made it easier for the admirals to visit either side of the country. Under the reorganization, the overall commanding officer of the reserves was titled Commander, Naval Reserve Force, to whom the Commander, Naval Air Reserve Force, established Oct. 1, 1983, reported while leading the air reserves. The change was to improve command and control of the Reserves and enhance readiness. Another change in titles occurred again in the early 2000s when the Naval Air Reserve became the NAFR.

Photo by Peter B. Mersky

A Fighter Squadron Composite (VFC) 12 A-4 and a Fighter Squadron (VF) 101 F-14 square off during a training flight in June 1989.

U.S. Navy photo

Four Naval Air Reserve F-8 flag officers gather by the flag staff at NAS Norfolk, Va. August 1991. All four flew the Crusader during combat cruises in Vietnam, and commanded one of two reserve VFP squadrons at Naval Air Facility (NAF) Washington, D.C. From left, Rear Adm. Richard Maughlin (VF-211), Rear Adm. Jay Miller (VFP-63), Rear Adm. Bud Flagg (VF-162) and Rear Adm. Tom Irwin (VF-24).

The 1980s and 1990s:
Reassessment and Rebirth

A shattering event in November 1979—the seizure of more than 50 American citizens by radical elements in strife-torn Iran, once a staunch U.S. ally—brought Americans together once again after years of internal division over the Vietnam War. With a change of administration and shifting political climate marked by the release of the remaining 51 hostages the same day President Reagan took office in January 1981, the U.S. began rebuilding its military capability.

The main force behind the rebuilding of the NAR—and in fact, the entire Navy—was Reagan's Secretary of the Navy, John Lehman. Appointed at 38, Lehman became one of the youngest people to hold the post. As a drilling Naval Air Reservist and A-6 bombardier/navigator, Lehman was well-versed in Navy traditions and operational requirements, and committed to bringing about a 600-ship Navy and better equipped NAR. A strong personality unused to failure, Lehman had his work cut out for him.

Vice Adm. Robert F. Dunn, a combat-experienced A-4 squadron commander during Operation Rolling Thunder (1965-1968), served as Commander, Naval Reserve Force from October 1982 to December 1983. He recalled his memories of Lehman's attempts to modernize the NAR in his oral history conducted by the U.S. Naval Institute:

"Traditionally, the reserve air components would get hand-me-down airplanes, certainly not the newest. John Lehman aimed to change all this. He insisted that the third F/A-18 squadron be a reserve squadron. It was strongly resisted by the active Navy, but with a firm-handed Secretary behind the move, it worked out fine."

Attack Squadron (VA) 303 was the first Reserve squadron to receive F/A-18A Hornets in October 1985, becoming Strike Fighter Squadron (VFA) 303. While the basic reorganization of the reserves in 1970 was still viable, it needed parity with the fleet. Even with the rebirth after the Pueblo recall, the reserves still flew aircraft that were in the early stages of fleet retirement, such as the F-4 and A-7.

However, some modernization continued. The ancient E-1B Tracer was replaced by the turboprop E-2 Hawkeye. Carrier Airborne Early Warning Squadron (VAW) 88 of CVWR-30 received its first E-2s in time to take them on active duty in October 1977. The four Reserve fighter squadrons exchanged their F-4Bs for refurbished and updated F-4Ns. Carrier Tactical Electronics Warfare Squadrons (VAQ) 209 and VAQ-309 began flying a new aircraft, the EA-6A "Electric Intruder," the electronic warfare (EW) version of Grumman's highly successful A-6 medium attack bomber, offering EW and attack capabilities to the Reserve Component air wings. Big KA-3Bs flew with Tactical Aerial Refueling Squadron (VAK) 209 and VAK-309 as dedicated aerial tanker and occasional pathfinder squadrons. VA-304 had been flying A-6E Intruders since August 1988, but the large two-man attack jets were getting too old and hard to maintain. The squadron was disestablished in 1994, as was CVWR-30.

All was not well, however, with other CVWR squadrons. The A-7B engines of the six light attack squadrons were aging more quickly than previously expected, and the reliability of the VA squadrons could not be counted on for the annual two-week active duty "cruise" of CVWR-30 at NAS Fallon, Nevada, which was nearly cancelled in May

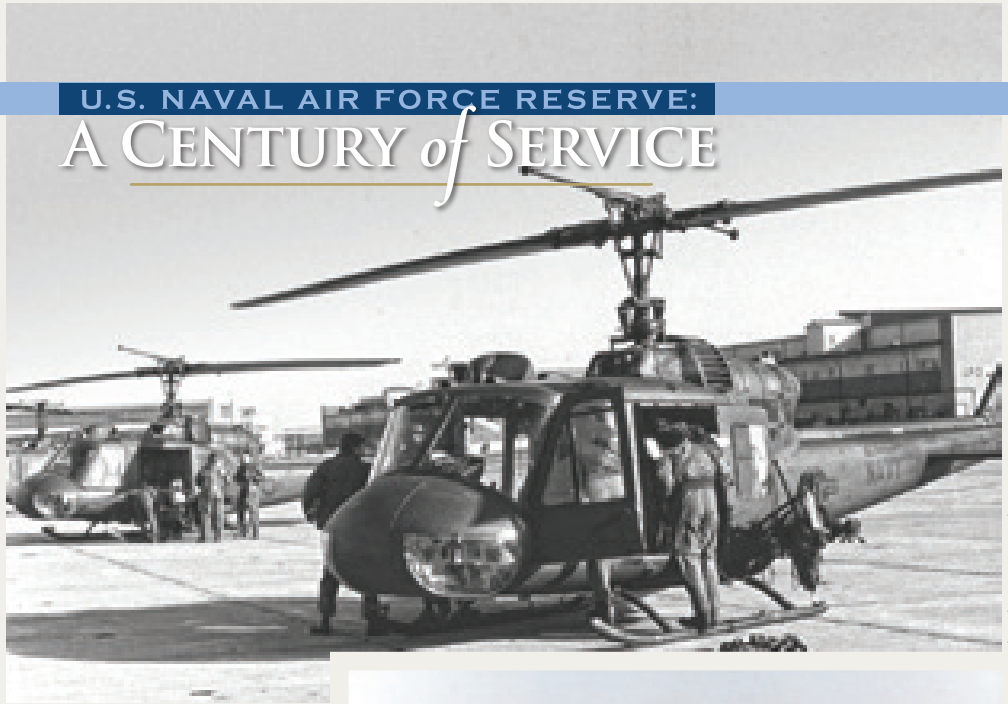


Photo by Peter B. Mersky

Huey gunships of Helicopter Attack (Light) Squadron (HAL) 4 and their crews prepare for a training mission from NAS Norfolk in 1985.

U.S. Navy photo

SH-2F Seasprites from Helicopter Anti-Submarine Squadron Light (HSL) 74 at South Weymouth, Mass., fly over the islands in Boston Harbor.

U.S. Navy photo

During a demonstration at NAS North Island, Calif. in August 1978, a Sailor drops from an SH-3 from HC-9 to show various rescue techniques.

1983. Orders were modified allowing two of the three A-7 units to still fly with the existing engines. A planned operational readiness inspection was cancelled.

At this same time, other NAR squadrons were receiving major upgrades. In June 1978, Norfolk's VAW-78 accepted its first E-2C Hawkeyes, bringing the RC into fleet compatibility and enabling squadron members to volunteer for periods of active duty with fleet squadrons in the Mediterranean.

In October 1984, the RC got its first Grumman F-14 Tomcats when VF-301 at Miramar accepted F-14As to replace squadron F-4Ns. A day earlier, Light Photographic Reconnaissance Squadron (VFP) 306, one of the two remaining U.S. Crusader squadrons, was disestablished, leaving VFP-206 as the last RF-8G squadron in the Navy until March 1987, when it too was disestablished with appropriate fanfare. Cmdr. Dave Strong, a former A-6 pilot and now the last U.S. Crusader skipper, shook hands with Vought chief test pilot John Konrad, who had taken the XF8U-1 on its first flight in March 1955. Thus, the first and last Crusader pilots said farewell to one of the Navy and Marine Corps' most loved and colorful fighters.

Another major development was the formation of the Patrol Squadron Master Augment Unit, or VP-MAU, which appeared Jan. 13, 1984. A new squadron was established at NAS Brunswick, Maine, a major VP base for the regular Navy. Oddly enough, since Brunswick had no NAR training unit, the new VP-MAU was placed under the administrative control of the commanding officer of NAS South Weymouth. The "Northern Sabers" were unique in that they flew the same P-3 Update II Orions as their fleet counterparts. The VP-MAU concept did not allow mobilization of the full unit, but let individual SELRES members be activated and sent to one of six fleet squadrons to Brunswick. VP-MAU members trained regularly with fleet squadrons. The new concept worked well, and another VP-MAU was established at NAS Moffett Field, south of San Francisco, California, in December 1986. Unfortunately, the MAUs were caught in a wave of cost-cutting following the Cold War and disestablished in 1991.

In the summer of 1989, echoing the 1976 TACAIR Test aboard USS Ranger with CVWR-30, CVWR-20 sailed aboard USS Dwight D. Eisenhower (CVN 69), leaving Pier 11 at Naval Station Norfolk, Virginia on July 24 for a 10-day cruise as the carrier's assigned air wing. The RC air crews did very well, earning a boarding rate of 94 percent. After three days at sea, the ship's commanding officer, Capt. (later Rear Adm.) J.J. Dantone, himself a fighter pilot, remarked, "I see no difference between USN and USNR aviators."

By the 1990s, the NAR was enjoying a decent period of modernization and participation by SELRES in all types of squadrons. But events nearly halfway around the globe would push the NAR onto the world stage and highlight the contribution reservists could and would play on short notice.

Reserves in the Desert

The Naval Air Reserve was called upon again after the surprise Iraqi invasion of Kuwait on Aug. 2, 1990. The small country was overwhelmed in a few days. After the initial shock the U.S., under President George H.W. Bush, who flew in World War II as an NAR combat pilot, gathered together a large coalition of countries, including a number of Arab nations, to eject the Iraqis under Saddam Hussein. But first, a huge effort was required to bring all the implements of war and the manpower to operate them to the potential combat theater of Southwest Asia. The overall effort was dubbed Operation Desert Shield. Several Reserve units were mobilized both en masse and also using individual reservists who had specific skills. No single NAR squadrons were activated except two helicopter squadrons, HCS-4 at Norfolk and HCS-5 at NAS Pt. Mugu.

By late December 1990, both squadrons had their two-helo detachments in-theater, under the combined call sign of "Spike." They operated from a tent city at Tabuk that also housed a SAR unit of the Royal Saudi Air Force that flew four UH-1Ns. As the Jan. 16, 1991, deadline neared for Iraq to withdraw its forces from Kuwait, the Spikes received orders to move to Al Jouf, northeast of Tabuk. When Desert Shield changed to Desert Storm on the early morning of Jan. 17, the combined Reserve SAR force was in place in Saudi Arabia.

When the war began, the Spikes were told to put a two-plane detachment at Ar'ar to be better prepared to respond to calls for CSAR support. The Americans were on 24-hour call, seven days a week. They were called out occasionally—there were several other SAR assets from other services—and eventually flew a total of 461 sorties while contributing individual crewmen to help their Saudi compatriots when night vision goggles were needed.

The NAR's participation in Desert Shield and Desert Storm did not involve a large number of entire squadrons recalled to active duty. Besides the two HCS squadrons—which would be redesginated Helicopter Sea Combat Squadrons (HSC) 84 and 85 in October 2006—four VR squadrons (VR-55 at Alameda, VR-57 at North Island, California, VR-58 at Jacksonville, Florida and VR-59 at Dallas, Texas) and their C-9s brought in large numbers of people and material during the preparatory stages. But overall, the Naval Reserve's participation was impressive, with individuals serving in the medical, public affairs, administrative and intelligence fields.

Photo by AT2 R. Felmer

An HH-60 of Helicopter Combat Support Special Squadron (HCS) 5 approaches Ar'ar, a forward base on Saudi Arabia's northeastern border with Iraq in February 1991.

Photo by AT2 R. Felmer

The HH-60H crew of HCS-5 goes through preflight checks before a mission in Desert Storm.

U.S. Navy photo courtesy of Capt. John Mooney

Cmdr. Don Blume (right) and Ens. Arielle Hall stand by their VT-28 T-6 trainer. The new trainer replaced the T-34C as the Navy's primary trainer and offers a more advanced capability.

U.S. Navy photo courtesy of Rick Morgan

The 2011 members of Electronic Attack Squadron (VAQ) 209 stand by their Air Wing Commander's bird at Bagram Airfield, Afghanistan.

Photo courtesy of Ted Carlson, Fotodynamics

An F-5N from Squadron Composite (VFC) 111 (top) and an F-5F from VFC-13 cruise over the Atlantic Ocean.

War in the Balkans

After the overwhelming success of Desert Storm, there were changes in the NAR. CVWR-30 was disestablished in 1994, leaving CVWR-20 as the only carrier-capable Reserve air wing. The wing included two squadrons—now designated VFCs—flying the F/A-18 Hornet, and two E-2 Hawkeye squadrons, VAW-77 and VAW-78. The "Night Wolves" of VAW-77 were shore-based to help with anti-drug trafficking, while the "Fighting Escargots" of VAW-78 were to go aboard ship, if needed. There were two dedicated adversary squadrons: VFC-12 at NAS Oceana, in Virginia Beach, and VFC-13, which was stationed at NAS Miramar, California before moving to NAS Fallon. These two highly specialized units first flew the A-4 before transitioning to the F/A-18. Today, VFC-13 flies the F-5. A third adversary squadron flying F-5s took on an old World War II squadron's designation as VFC-111, and is based at NAS Key West, Florida. CVWR-20's rotary-wing contingent was HS-75, equipped with Sikorsky SH-60F and then HH-60H SAR helicopters.

Perhaps the most oft-publicized NAR squadron is the aforementioned Electronic Attack Squadron (VAQ) 209 "Star Warriors," who adopted Darth Vader as their squadron mascot when they formed up in 1977, the same year "Star Wars" hit theaters. The squadron transitioned in 1989 from the EA-6A to the four-seat EA-6B Prowler, which featured increased capabilities over the "Electric Intruder." Its sister squadron, VAQ-309, made the same transition in 1990 before being disestablished in 1994, along with the rest of its air wing, CVWR-30.

In an unusual situation, NATO found itself involved in its first shooting war during the war in the Balkans, which spanned 1991 to 2001. Elements from many member nations were soon participating, including VAQ-209, based at Naval Air Facility, Washington, D.C., a tenant command since May 1990 at Andrews Air Force Base in Maryland.

On April 16, 1999, with only four days' notice, VAQ-209 was on its way to Aviano in northeastern Italy to support Operation Allied Force, a major campaign in the war-torn Balkans. The fleet's complement of overworked Prowlers needed reinforcement to support what had become a 24/7 flight schedule. VAQ-209 flew 150 combat sorties before returning to Andrews on June 27.

The squadron continued its active-duty deployments with a March 2000 trip to Incirlik, Turkey, in support of Operation Northern Watch, a 2001 deployment to Saudi Arabia to help with Operation Southern Watch, and a 2002 return to Incirlik.

As former Prowler ECMO (Electronic Counter-Measures Officer) Lt. Cmdr. Rick Morgan notes:

Over the next 15 years, the Star Warriors made nine major deployments and flew combat missions in support of European, Pacific and Central Commands. Their ability to send EA-6Bs overseas for short periods (typically 90 days or less) gave the Navy a way to balance the new Joint EW requirement they got when the [U.S.] Air Force retired [its] EF-111 Ravens.

In the end, VAQ-209 made more forward deployments and flew more combat time than the rest of CVWR-20 and CVWR-30 combined.

In the Balkans [VAQ-209] was doing mostly classic SEAD [suppression of enemy air defenses] against the Serbian air defense network…Their deployments to Iraq and Afghanistan were largely counter-communications and counter-IED. The later mission was developed, very rapidly, by the community when RF-detonated IEDs became a major killer of [Allied] forces in both theaters.

Post-9/11:
New Responsibilities and the "Hunters" Go to War

The Sept. 11 terrorist attacks brought all U.S. assets into play, including various Reserve elements. VAQ-209 deployed to Afghanistan for the first time between January and March 2008, again between March and May 2009, and for a third time in November 2009.

Following the 9/11 attacks and the buildup that resulted in Operation Enduring Freedom in Afghanistan and later Operation Iraqi Freedom, the NAR, like most of America's military forces, responded in a massive display of action against terrorist forces. By 2003, an established sequence of deployments of ships, squadrons and other groups had seen much success, but had not completely removed many of Hussein's allies, especially in Afghanistan.

Carriers in the eastern Mediterranean were tasked with regular attacks in the Northern Arabian Gulf to support missions by Special Operations Forces (SOF) in northern Iraq. Internal political pressure in Turkey prevented the use of Turkish bases for staging purposes, placing a great burden on assets in the Mediterranean to carry out the war.

Rumors of mobilization of a single NAR squadron began circulating during the summer of 2002, and finally, that October, with three days to report, VFA-201 at Naval Air Station Fort Worth Joint Reserve Base, Texas, received orders to join USS Theodore Roosevelt (CVN 71) and replace one of its carrier air wing's (CVW-8) F/A-18 Hornet squadrons due for rotation.

Flying obsolescent F/A-18As, the "Hunters" of VFA-201 traded 12 of their Alphas in exchange for a dozen F/A-18A+ Hornets from their sister CVWR-20 squadron VFA-203. With the more advanced Hornets, which could accommodate current weapons carried by the F/A-18C, E and F models in the fleet, VFA-201 threw itself into hours of flight and maintenance training to be ready to deploy. After more than two months of intense workups, the Hunters joined CVW-8. On Jan. 31, 2003, the Roosevelt received orders to head out with its revamped air wing, which now included the first NAR squadron to be mobilized for combat since the Korean War. VFA-201 deployed with 217 officers and enlisted personnel, including both SELRES and FTS. There were engineers, construction contractors and airline technicians in the Hunters' SELRES.

CVW-8 began combat operations on the night of March 22, 2003, when VFA-201 launched four squadron F/A-18s, each carrying two 2,000-pound GBU-31 Joint Direct Attack Munitions smart bombs, as part of a wing strike package against targets in the beleaguered Iraqi town of Fallujah.

Two days later, the Roosevelt headed north to begin a series of close air support missions, normally a Marine Corps specialty. Enemy opposition occasionally lit up the night sky with flak that appeared as green streaks in the pilots' night vision goggles. They reported hunkering down in their cockpits as they broke hard to the north to get out of the area after delivering

Photo by Capt. Mark Brazelton

An F/A-18A+ of Strike Fighter Squadron (VFA) 201 "Hunters" on a mission over Afghanistan in April 2003.

Photo courtesy of Capt. Mark Brazelton

A VAQ-209 Growler shoots a High-speed Anti-Radiation Missile (HARM).

U.S. Navy photo

A ground crew and their pilot stand by their Electronic Attack Squadron (VAQ) 209 EA-18G Growler on deployment in Guam.

Helicopter Maritime Strike Squadron (HSM) 60 flies an SH-60B.

Photos by Ted Carlson, Fotodynamics

A P-3C Orion from Patrol Squadron (VP) 62 out of NAS Jacksonville, Fla.

their ordnance. It was certainly not a drill weekend. The NAR was really in the war.

VFA-201 participated in daily strikes with other CVW-8 squadrons, including VF-213 and its F-14Ds and the EA-6Bs from VAQ-141. By the time they returned to the U.S. in late May, the Hunters had dropped more than 250,000 pounds of ordnance while flying 324 combat sorties across 1,407 flight hours. The squadron also enjoyed a 99-percent boarding rate, which earned it the CVW-8 "Top Hook" award.

People from several VR squadrons as well as HSC-84 and HSC-85 were again mobilized for CSAR duty from bases in Iraq and flying missions for SOF. HSC-84 maintained a presence in the Middle East until the entire squadron returned to Norfolk on Oct. 12, 2015. On March 19, HSC-84 was disestablished as a cost-cutting measure.

The Navy retained HSC-85 in San Diego as a dedicated SOF support squadron. Tactical Support Units (TSUs) currently help provide on-going training to maintain the proper level of expertise in prospective HSC-85 members and the Active Component HSC squadrons.

NAFR currently consists of Squadron Augmentation Units (SAUs), where RC instructor pilots are attached and operationally support every type model-series of Active Component aircraft at every Fleet Replacement Squadron (FRS), which are often incorrectly referred to by the older designation, Replacement Air Group (RAG). The remaining SAUs support the Chief of Naval Air Training (CNATRA) mission with RC pilots. NAFR squadrons and SAUs span the United States and provide constant operational support to the U.S. Navy.

On April 1, 2007, CVWR-20 was redesignated Tactical Support Wing (TSW) based at NAS Fort Worth, Texas Joint Reserve Base. The change came as VFA-203 and VAW-78 disestablished in 2005 following the 2000 findings of the Naval Reserve Redesign study. VFA-201 was also disestablished in June 2007, and VAW-77 went in 2013. Now composed of five squadrons and five SAUs, CVWR-20 could no longer be considered a deployable air wing, especially with the focus on VAQ-209's ongoing expeditionary support of the fleet, and the fleet's demand for adversary support. The TSW now includes one strike fighter squadron, VFA-204 at New Orleans; one electronic attack squadron, VAQ-209 at NAS Whidbey Island with their new EA-18G Growler that replaced the veteran EA-6B Prowler; and three adversary squadrons, VFC-12 at NAS Oceana, VFC-13 at NAS Fallon and VFC-111 at NAS Key West. The Navy cut most of its Active Component adversary program beginning in 1994. The Reserve VFCs went through a succession of different aircraft starting with the A-4, and then the F/A-18 and F-5.

Reservists have long been integrated with CNATRA. In fall 2001, FTS aviators were assigned to squadrons and wings while the first officers-in-charge were picked from other Reserve communities. There are currently 17 SAUs across five training air wings (Pensacola, Whiting, Meridian, Kingsville and Corpus Christi). CNATRA SELRES aviators each contribute a minimum of 60 days a year to producing new Naval Aviators. Reserve Component instructors, both SELRES and FTS, comprise 18-to-22 percent of the training program's requirement.

The NAFR currently also consists of the Maritime Support Wing, which was established July 2015 under the Active Reserve Initiative to maintain the readiness of the Navy's Reserve helicopter and maritime patrol (VP) units. Four Reserve Force Squadrons (RESFORONs) were a drastic curtailment of the expansive Reserve VP community and the helicopter specialty squadrons. The once-busy Reserve VP community faces a period of difficult decisions with only two P-3C squadrons—VP-62 at NAS Whidbey Island and VP-69 at NAS Jacksonville. While the fleet is slowly transitioning to the Boeing P-8, there are no plans to bring the 737 airliner derivative into the reserves. And as noted earlier, HSC-85 is the only remaining dedicated rotary-wing SOF support squadron, while Helicopter Maritime Strike Squadron (HSM) 60 flies the MH-60R.

Established in 2001, HSL-60 was redesignated HSM-60 in July 2015 after completing a full transition to the MH-60R Seahawk. The "Jaguars" continue deploying detachments aboard U.S. Navy ships, performing a variety of missions including SAR, naval gunfire support and counter-drug operations. One recently deployed detachment, embarked on USS Lassen (DDG 82), supported Southern Command's Combatting Transnational Organized Crime mission. Since getting underway in February , this

Photo by Ted Carlson, Fotodynamics

A Fleet Logistics Support Squadron (VR) 58 C-40A with its distinctive winglets.

Jaguar detachment has conducted nine airborne use-of-force interdictions/seizures, detained 31 personnel and disrupted more than 7,600 kilos of narcotics in support of Operation Martillo.

The Naval Air Force Reserve continues to go through periods of change and transition, fine-tuning its missions and the skills of its individual members. Its transport squadrons (VRs) are also refining their roster of equipment to meet cost-saving measures, while one of the possibly least known but certainly important groups is the Fleet Logistics Support Wing (FSLW). Anyone in the Navy has probably used the services of one of the wing's aircraft and crew. They could be referred to as the Navy's airline, carrying large amounts of vital freight to support the large number of operations and units throughout the world.

The veteran C-9, once flown by as many as 15 squadrons, by 2014 had seen three of its VR squadrons disestablished and the FLSW retire its airframe. Now, it is the C-9 that is going away, replaced by big Boeing 737-700s (designated C-40s in the Navy). Initial C-40As were delivered with standard wings, but airline use showed significant fuel savings when winglets were installed. Thus, from C-40A No. 9, the new transports came with winglets built by Boeing. Earlier aircraft were retrofitted with winglets. The C-40 combines the fuselage of a Boeing 747-700C with the strengthened wings and landing gear of the 737-800, along with the modification of a large cargo door. Five VRs have C-40s and another five squadrons use C-130Ts. One squadron flies C-20Gs, military Gulfstream IVs, while two Executive Transport Detachments fly senior Navy officials in C-37s (Gulfstream Vs) and C-20Gs.

Rear Adm. William Crane, Chief, Navy Air Force Reserve, recently noted that "the VR community specializes in short-notice emergent, high-priority lift, and CNAF considers our medium-lift aircraft to be his lowest-density/highest-demand airframes on a regular basis."

The VR wing is deployed throughout the year outside the continental United States supporting theater commanders' logistics requirements.

A few of the wing's most recent missions include quickly transporting Sailors captured and eventually released by Iran when they mistakenly entered the nation's waters in January; evacuating Navy personnel on Andros Island and 28,000 pounds of cargo when a Category 4 hurricane bore down on the Bahamas; and C-130 support of SEAL operations for a surge deployment during U.S. Pacific Command area of responsibility operations.

Lt. Wes Holzapfel, public affairs officer for the CNAFR summed up today's Naval Air Force Reserve:

The Sailors of NAFR are warfighters who provide the fleet with operational support to prepare for and operate forward in any theater. Today's NAFR consists of 23 fixed-wing and rotary-wing aircraft squadrons as well as 26 SAUs, some of which support every type/model/series of active component aircraft at every Fleet Replacement Squadron while others support CNATRA's mission. NAFR squadrons span the United States and maintain a constant presence throughout the world.

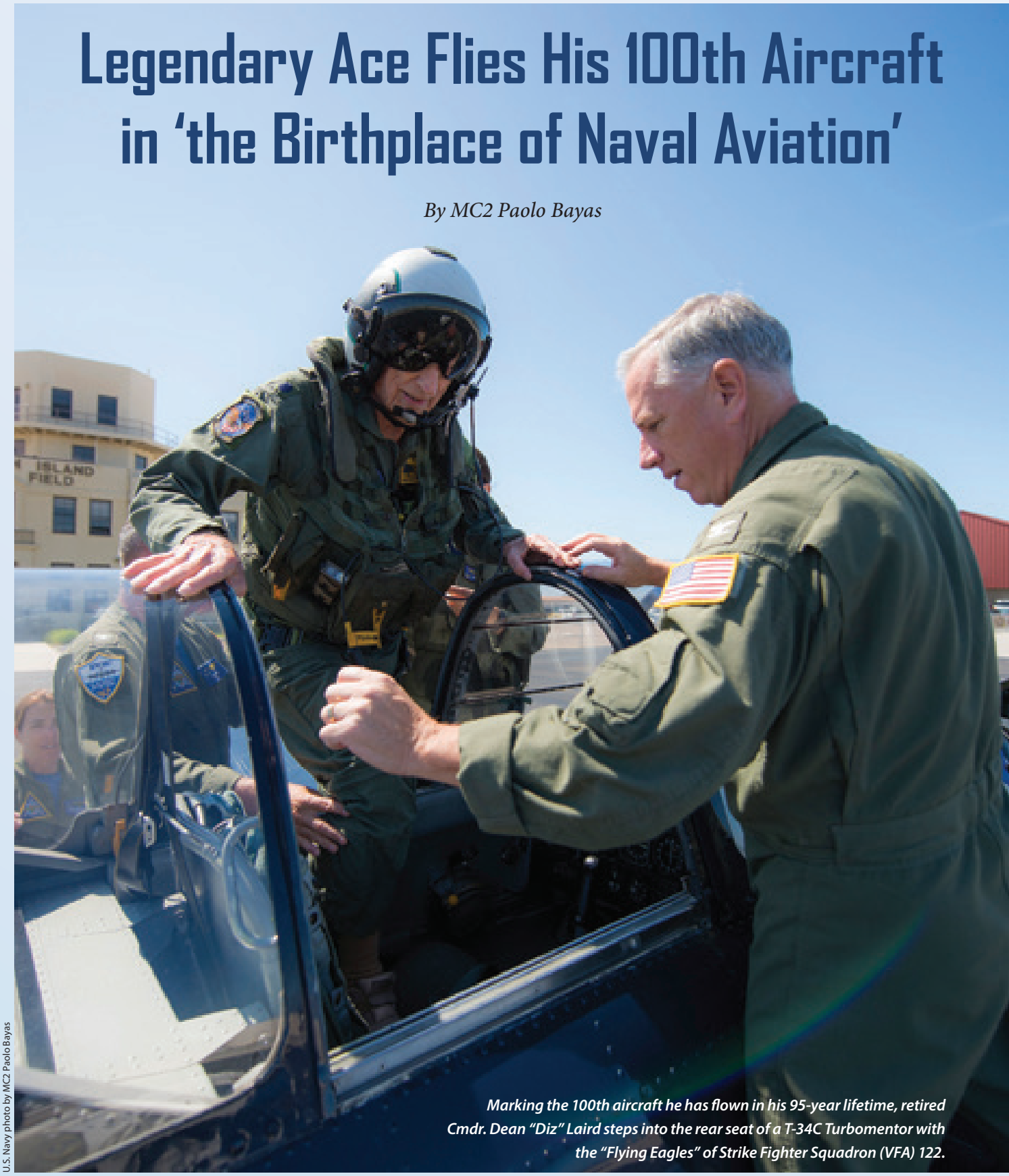
The NARF has slimmed down since the 1980s while retaining its capabilities. To borrow from the title of a recent book by Cmdr. David F. Winkler commemorating the Naval Reserve's centennial of 2015, the "Naval Air Reserve is Ready Then, Ready Now, Ready Always."

Cmdr. Peter B. Mersky, USNR (Ret.) was commissioned through Aviation Officer Candidate School in 1968 and remained a reservist, serving in various intelligence billets as well as two tours with Light Photographic Reconnaissance Squadron (VFP) 306 until retiring in 1992. He was the first civilian editor of "Approach" magazine, has been a volunteer associate with Naval Aviation News since 1971, and has written NAN's book review column since 1982 to include some 700 book reviews for NAN and other publications plus 16 books on U.S. Navy and Marine Corps Aviation.

Author Acknowledgements: I thank the following people in order of seniority for taking time from their busy schedules to provide advice, information and, most importantly, support. Vice Adm. Robert F. Dunn, USN (Ret.), former Chief, Naval Reserve (CNR); Vice Adm. John G. Cotton, USN (Ret.), former CNR; Vice Adm. Robin Braun, CNR; Rear Adm. Samuel J. Cox, USN, (Ret), Director, Naval History & Heritage Command; Rear Adm. John Sadler, Deputy Director Maritime Operations, U.S. Fleet Forces Command; Rear Adm. William M. Crane, Chief Navy Air Force Reserve (CNAFR); Capt. Rosario Rausa, USNR, Training and Administration of Reserves (TAR) (Ret.); Capt. Scott Eargle, Commodore, Fleet Logistics Support Wing; Capt. Marc Orgain, Commodore Maritime Support Wing; Capt. John P. Mooney, Chief of Naval Air Training (CNATRA), Reserve Component Commander; Capt. Mark D. Brazelton, Deputy Commodore Tactical Support Wing (TSW); Capt. R.T. Rascoll and Lt. Dani Still, Navy Air Logistics Office; Cmdr. Rob Teague, Public Affairs Officer, TSW; Lt. Cmdr. William F. Murphy, Deputy Executive Assistant to CNR; Lt. Cmdr. Rick Morgan, USN (Ret.); Lt. Wesley A. Holzapfel, Public Affairs Officer, CNAFR; Lt. Adamantios Kouloumoundras, Electronic Attack Squadron (VAQ) 209; Aviation Warfare Systems Operator 1st Class Marc Frattasio, USNR (Ret.); Nicholas J. Thrasher, Editor in Chief, Naval Aviation Museum Foundation; Tony Holmes, Ted Carlson and Warren Thompson.

Legendary Ace Flies His 100th Aircraft in 'the Birthplace of Naval Aviation'

By MC2 Paolo Bayas



U.S. Navy photo by MC2 Paolo Bayas

Marking the 100th aircraft he has flown in his 95-year lifetime, retired Cmdr. Dean "Diz" Laird steps into the rear seat of a T-34C Turbomentor with the "Flying Eagles" of Strike Fighter Squadron (VFA) 122.

U.S. Navy photos by MC2 Paolo Bayas

Retired Cmdr. Dean "Diz" Laird, right, and Lt. Cmdr. Nicole Johnson, a pilot instructor with the "Flying Eagles" of Strike Fighter Squadron (VFA) 122, conduct a flight brief for a T-34C Turbomentor.

CORONADO, Calif.—Already famous for being the lone known ace to achieve victories against both German and Japanese aircraft during World War II and later becoming a stunt pilot for the 20th Century Fox-film "Tora Tora Tora" in 1969, retired Cmdr. Dean "Diz" Laird flew his 100th aircraft July 9 above "the birthplace of Naval Aviation."

A 29-year veteran, Laird, 95, also served in Korea and Vietnam, operated in 175 combat and training missions, served on 12 different carriers, flew in the Navy's first jet squadron, was the first person to land a jet-powered aircraft aboard USS Midway and has the most arrested landings on a straight-deck carrier in U.S. Navy history.

"I want to thank everyone who took part in making this happen," Laird said. "When I found out that I was going to be able to do this, I was shocked. I couldn't believe it."

Laird said his 100th plane wasn't for an achievement, medal or trophy—he wanted to set this milestone for himself.

Laird flew in the rear seat of a T-34C Turbomentor with Lt. Cmdr. Nicole Johnson, a fleet replacement squadron instructor pilot with the "Flying Eagles" of Strike Fighter Squadron (VFA) 122.

"I was so excited and honored to fly with a true legend. How many people can say they flew with 'Diz' Laird?" Johnson said. "Then he had to make me look bad by being a better pilot at 95 [years old]. It is men like this that paved the way for the rest of us."

She added that flying 100 different aircraft is a tremendous achievement for any pilot. In comparison, Johnson has flown only 15 aircraft in her 12-year career as a pilot.

"Aviation is a lot different now from what it was, especially when you think about how he is an ace," she said. "We train for air-to-air combat our whole career, but very rarely, in this day and age, does that actually happen. It's phenomenal to have just had a conversation and fly with him."

The 95-year-old legend had some words of advice for younger naval aviators. He said that his "policy has always been that every fighter pilot has two main assets once they're airborne. One is altitude and the other is speed. Never give up one, without gaining something on the other."

During the flight, Laird and Johnson flew off the coast of San Diego for a bit of sightseeing followed by a few aileron rolls in a training area before coming in for a landing.

Laird has been recognized on Coronado's Avenue of Heroes and continues to actively participate in Naval Aviation organizations.

Mass Communication Specialist 2nd Class Paolo Bayas supports CNAF Public Affairs.

Search for Sunken PAX Aircraft Continues in Chesapeake Bay

By Jeff Newman

U.S. Navy photo by Heather Brown

More than 200 sonar targets—some of which may represent parts of aircraft or debris fields—were found in August as underwater archaeologists continued their search for U.S. Navy aircraft lost in training exercises more than a half century ago off the coast of Patuxent River Naval Air Station, Maryland.

The underwater archaeology team with the Naval History and Heritage Command's Underwater Archaeology Branch followed up on its field work conducted last August. At the time, an FJ-1 Fury lost in 1947—the year the fighter entered service, becoming the Navy's first operational jet—was among the aircraft on the search list. This year the archeologists returned still searching for the Fury, and added an HOK-1 Huskie helicopter lost in 1956.

While those aircraft were the two of most interest to the team, led by underwater archaeologist George Schwarz, the search extended further south in the Chesapeake Bay, where an XF8F-1 Bearcat was downed in 1945. Possible aircraft marked on previous surveys include a SNC-1 Falcon lost in 1943, plus an F9F Panther and TV-2 Shooting Star.

U.S. Navy photo by Jeff Newman

The survey, conducted from July 25 through Aug. 3 aboard a 25-foot research vessel, consisted of scanning the seafloor with a side scan sonar, looking for objects with distinct, straight lines indicative of man-made, forged material. Schwarz and his team used a GPS tracker to follow a strict grid pattern and ensure complete coverage of the search area, which spanned roughly 3 square nautical miles.

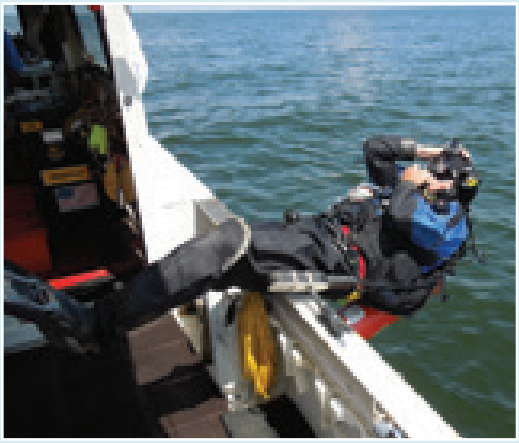
The imprecise mishap reports and other documentation used to identify downed aircraft that went unrecovered in the bay necessitated a large search area, Schwarz said. For example, a report on the downed Fury simply said it crashed about 1 mile off base, so the archaeologists made the search area a wide swath of water extending 1 mile from the runway the Fury took off from.

Each time the sonar picked up something that looked like it could be part of a downed aircraft, one of the team members jotted down their location within the grid. Those positions were then relayed to a second research boat owned by Dave Howe, a retired Navy lawyer and current secretary of the nonprofit Institute of Maritime History (IMH), whose three-person crew of volunteer divers checked out the objects picked up by Schwarz's sonar scans.

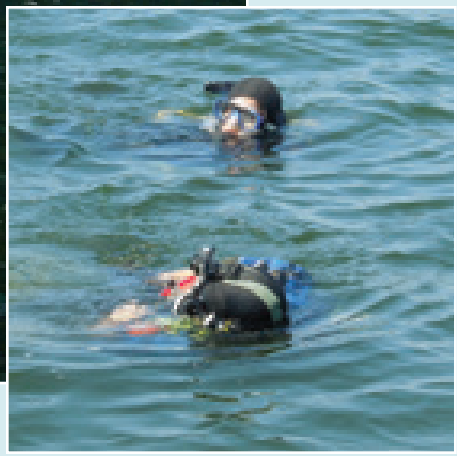
Two of the divers, Dan Lynberg and Bill Isbell, believed they may have found part of the HOK-1 during an early afternoon Aug. 2 dive. Upon returning to the surface, Lynberg, a former Marine, said they found a 58-inch piece of channeled, structural metal, likely aluminum or steel, that could have been a piece of a helicopter frame or tail boom. "We found a lot of stuff," Lynberg said. "None of [the finds] were completely intact airplanes, but

Naval History and Heritage Command (NHHC) Underwater Archaeology Branch archaeologist George Schwarz and Institute of Maritime History (IMH) volunteer Dave Howe review sonar targets Aug. 2 while searching for sunken aircraft in the Chesapeake Bay off the coast of Patuxent River Naval Air Station, Md.

U.S. Navy photos by Jeff Newman



IMH volunteer Dan Lynberg dives into the Chesapeake Bay as part of a NHHC survey of sunken aircraft.



IMH intern Konpel Kaur, top, and Lynberg, bottom, prepare to submerge in search of sunken aircraft.

Lynberg, left, and Kaur, center, remove their gear while discussing their dive with volunteer Bill Isbell.

several of the fragments down there are definitely structural, metal fragments, so I think the survey was very successful."

Howe and his team then moved on to another dive site relayed by Schwarz's team, but once he learned the location, Lynberg was certain that what the archaeologists had found was not aircraft wreckage, but that of the Cato, a Revolutionary War vessel sunk in January 1781 after a British flotilla intercepted it and three companion ships off of Cedar Point—now the northeastern tip of the air station.

Carrying cargoes of flour meant to help fund the war effort, the crews of the Cato and two of the sister ships ran their vessels ashore in hopes of avoiding capture. The British boarded the Cato and Hawk, burning the latter. But while they were searching the Cato, its magazine detonated, killing sailors on both sides, and sinking the ship in pieces.

Lynberg said he and other local historians spent a year and a half diving and searching for the Cato until he discovered what he is certain is the vessel's remains in January 2007. He and Konpel Kaur, a University of Oxford student who crossed the Atlantic to intern with Howe this summer, dove to confirm that Schwarz's sonar target was indeed the suspected Cato wreckage.

Schwarz and his team will now take their data and the observations collected by Howe's team back to the lab for analysis and determine whether to send out additional dive teams to confirm any findings as downed aircraft. He expects to make at least one more trip to Patuxent River next summer to continue sweeping the bay's depths for lost-but-unforgotten aircraft.

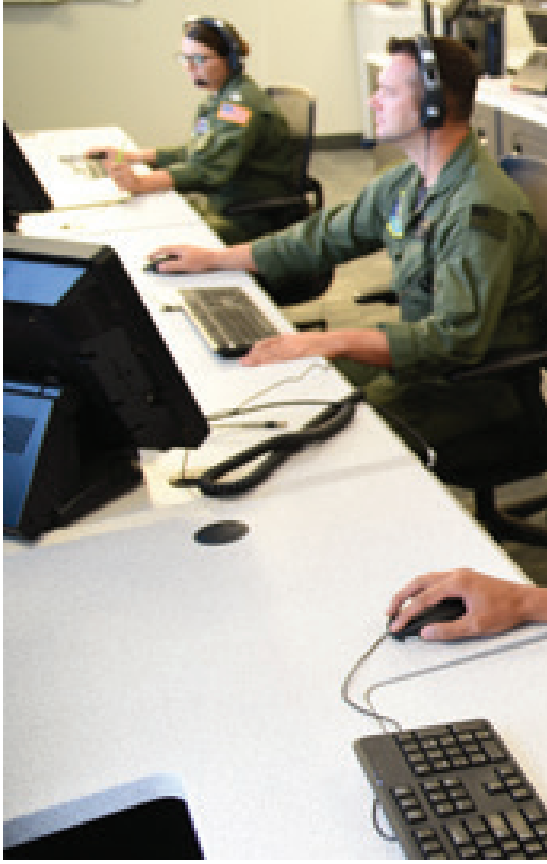
"Our week and a half on the Chesapeake was very successful, thanks to our colleagues at IMH and Navy partners at NAS Patuxent River," Schwarz said. "We have more than 200 sonar targets of interest to further investigate. We plan to process the sonar data and prepare for a follow up survey to ground truth the most promising of these targets, and to search in a few other areas to the north that we did not get to this summer. Ultimately, we hope our work will help us locate and protect these few remaining 1940s and 50s sites of training craft tested by Navy pilots during these developmental years of Naval Aviation."

Jeff Newman is a staff writer and contributing editor for Naval Aviation News.

Unmanned? NOT EXACTLY

by Jeff Newman

With a name like "unmanned aerial vehicles," it can be hard to remember that UAVs, at least for the time being, still depend on human aircrews for their safe operation and tasking.



The unmanned MQ-4C Triton—the U.S. Navy's new persistent, high-altitude intelligence, surveillance and reconnaissance (ISR) platform—is no different, as Air Test and Evaluation Squadron (VX) 20 pilots preparing for the aircraft's operational debut next year can attest.

A Triton's aircrew consists of four members: an air vehicle operator (AVO), tactical coordinator (TACCO) and two mission payload operators (MPOs).

Though the Triton's flight control system technically flies the aircraft, it needs to be told where to go. That's where the AVO comes in.

"As the aircraft commander, or the AVO, I'm the 'pilot' of the Triton," said Lt. Cmdr. Tim Beebe, who leads a four-person crew as part of VX-20's Triton program. "I'm in charge of safe conduct of the flight from startup to shutdown, as well as the tactical maneuvering of the aircraft on station."

Meanwhile, the MPOs control the Triton's radar, electro-optical/infrared (EO/IR) camera, automatic identification system (AIS) receiver, and electronic support measures (ESM), a four-sensor suite that allows it to locate, identify and track targets across wide swaths of open ocean from altitudes reaching 60,000 feet.

"My job is to operate all the equipment that we use to track various ships and targets of interest over the water," said Naval Aircrewman Avionics Chief Petty Officer Al Lombardo, a Triton MPO on Beebe's crew. "Triton's mission is to find ships and targets of interest, and we're the ones actually using the sensors to collect the data that we need."

Data gathered by the MPOs is then relayed to the TACCO, who "takes the sensor information and determines where we're going to go with it," said Lt. Alyssa Wilson. "I'm kind of the big picture person. I get radar tracks, EO/IR imagery, ESM data, and we look at it all and we determine the things that we need to push out to a strike group or disseminate via live stream video to the rest of the fleet."

Perhaps what most distinguishes the MQ-4C from previous ISR platforms is its persistence—because it is controlled remotely, crews can be swapped out before they become fatigued, allowing a single Triton to remain on station up to 30 hours without refueling.

"Instead of having to land and swap out an aircrew or send up an entirely different plane, we can actually just bring in a whole set of crew halfway through a mission and have someone else take over from where we were at, so it keeps us on station a lot longer than it would in a regular manned aircraft," Lombardo said.

The Triton is designed to work in tandem with the manned P-8A Poseidon patrol aircraft, sweeping the seas for targets and allowing the P-8 to focus more on its anti-submarine and anti-surface warfare missions.

The Triton's mission and crew makeup also closely mirror those of the P-8 and its predecessor, the P-3 Orion, so it makes sense that the Navy is currently recruiting its MQ-4C crews from those platforms. Beebe and his three crew members, for instance, all flew P-8s or P-3s prior to joining the Triton program.

"For our aircrews, flying Triton is what we call a 'second tour job.' So they'll fly a manned aircraft first, fly a P-3 or a P-8, and then come here to fly Triton afterwards," Beebe said. "This allows the Navy to bring in someone who's already qualified in a naval aircraft and has demonstrated the necessary aviation skills to accomplish the mission. Also, most Triton aircrew will come directly from flying manned aircraft in the same operational environment that Triton is going to be operating in, so they're already familiar with the objectives and missions of that area of operations."

"I think the biggest contribution to Triton was our fleet experience, just knowing what's out there, knowing what kind of mission sets we do and how we can perform that same mission set with this system," Wilson said.

Naval Aircrewman Operator Petty Officer 2nd Class Adrian Asetre, foreground, works as part of a four-member MQ-4C Triton test crew based at Naval Air Station Patuxent River, Md. A mission payload operator (MPO), Asetre is one of two crew members who operate the Triton's suite of four sensors.

U.S. Navy photos by Jeff Newman

The second MPO, Naval Aircrewman Avionics Chief Petty Officer Al Lombardo checks returns from an MQ-4C Triton's sensors.

As the air vehicle operator, Lt. Cmdr. Tim Beebe leads a four-person crew as part of Air Test and Evaluation Squadron (VX) 20's MQ-4C Triton program.

But while the mission and crew makeup may be familiar, flying Triton from a control room is a very different experience from flying aboard a P-8 or P-3 over the Pacific.

"You are not physically in the aircraft. You are in a building operating while the aircraft is miles and miles away, and because of that it just feels a bit different and it takes a little bit of time to get used to," said Naval Aircrewman Operator Petty Officer 2nd Class Adrian Asetre, the second MPO and final member of Beebe's four-person crew.

"The one thing about Triton is that, once it's in the air, it could technically do most of its mission without any pilot input. However, that's not the way we currently utilize it; we give it certain commands to allow us to more efficiently and tactically maneuver the aircraft," Beebe said. "The main difference between flying Triton and manned aircraft is that with Triton you're sitting here at what we call 'one G, zero knots,' but the aircraft you're controlling is out there hurtling through space, usually in the vicinity of other aircraft, and you've got to be aware of that, and respect that, at all times."

Another big difference mentioned by Beebe and his crew members is how their situational awareness must be informed exclusively through the aircraft's sensors.

"Not actually being physically on the aircraft, it was a new thing for me," Lombardo said. "You have to trust the inputs that your screens are giving you, because you can't physically see anything happening."

"As a normal pilot, you're sitting in the aircraft, you're strapped in, you can hear the engine running, you can look out the window and see other aircraft—we don't have any of that with Triton, which creates

U.S. Navy photo by Jeff Newman

Lt. Alyssa Wilson, the tactical coordinator on a four-person crew testing the MQ-4C Triton , determines what to do with data collected by the aircraft's sensors.

its own set of challenges" Beebe said. "A lot of what we do requires us to rely on outside sources for our information on the aircraft itself as well as the aircraft's sensors, what they're telling us the aircraft is doing."

In some ways, those differences have made it difficult for the Triton program to recruit pilots, who went to flight school intending to fly traditionally manned aircraft, and often aren't keen on leaving that thrill behind.

"I think it's a challenge because you're not putting on a G-suit, you're not strapping up and carrying your helmet out like 'Top Gun,' so it kind of takes a little bit of the glamour out of it," Wilson said. "But I think the mission is so important and I think that this is the future of the Navy, so I think you can still do what you were trained to do as a TACCO, but you can just do it in a different environment and still make an impact on the fleet."

Plus, there are benefits to flying unmanned aircraft. For one, "it's easier to stretch your legs out a bit during long missions," Lombardo said.

Beyond the crew's comfort, there is also the knowledge that they are at the forefront of a groundbreaking platform that will change the way the Navy keeps watch over the seas.

"Anytime that you can actually help develop something that's going to help the warfighters down range, it's always a good feeling," Lombardo said. "Years from now, if you see something and you know that you actually had a part in making it happen, it's always just a good feeling to have."

"The P-3 and the P-8 are so established, but for us and what we get to do, we're making history by being some of those first people in as the Triton operators," Wilson said. "I think that's really cool, that we can affect change for the concept of operations and for what we're planning on doing with this system, and make a difference because we're helping that process along."

"UAVs, they haven't reached their peak or their full potential, and being part of this community as an operator is rewarding, especially when UAVs are the future," Asetre said.

"With its high altitude, its long endurance, and the very good sensor suite that it has, we're going to provide the fleet with a level of situational awareness that's unparalleled currently, and that's pretty exciting," Beebe said. "Triton and unmanned aviation as a whole are going to be a large part of the future of aviation, and Triton is one of the newest acquisition projects in the Navy, so if you want to be involved in some of the newest stuff that's going on, some of the most cutting-edge technology, this is where you want to be."

Jeff Newman is a staff writer and contributing editor for Naval Aviation News.

First Triton Squadron Recruiting Members

The U.S. Navy's first MQ-4C Triton squadron is looking for new members who want to be at the forefront of "the birth of new technology in the Navy," said Cmdr. Benjamin Stinespring, incoming Commanding Officer of Unmanned Patrol Squadron (VUP) 19.

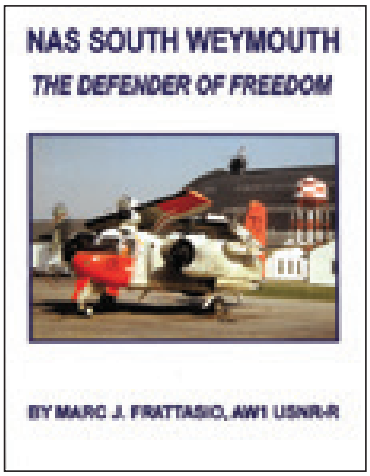
Interested Sailors, particularly those from the existing maritime patrol and reconnaissance community, can apply to join VUP-19 by marking it as a preference in their standard detailing process, or by talking to their current Commanding Officers.

"Everybody is coming to us in a different manner as far as where they are in their career path, but anybody who is volunteering to come to us can definitely make a case with their command and with their detailer that what they are bringing to the remote-piloted aircraft mission is important and we would welcome them," said Cmdr. John Levoy, VUP-19's incoming executive officer, who along with Stinespring will assume his post Oct. 28.

"Anybody who comes to this squadron will have the chance to lay the ground work for the next step in maritime patrol and reconnaissance," Stinespring said.

Professional Reading

By Cmdr. Peter Mersky, USNR (Ret.)



NAS South Weymouth, the Defender of Freedom

Marc J. Frattasio, AW1, USNR (Ret). 2016. 739 pp. Ill. $49 (softcover), $60 (hardcover)

When you get a huge book like this with more than 700 heavily illustrated pages, it is obviously a true labor of love and should be treated as such. The author is a retired P-3 aircrewman' and knows whereof he writes. His wife is also a retired aviation storekeeper (AK) who helped maintain her husband's P-3s at NAS South Weymouth, Massachusetts. He has also written several other books about the Naval Air Reserve in New England, primarily in the Boston area.

This book is self-published, allowing him to speak his mind as he writes and also include the text and photographs that the subject requires.

Although "SoWey" closed in 1997 after a 55-year history, it lives on in the Shea Museum on the grounds of the NAS, and in the memories of the Navy and Marine Corps vets and civilians who worked on the air station. Their enthusiastic support of this grassroots assembly of memorabilia has resulted in a surprising display that is a popular site in the Bay State area. It is named for Commander John Shea, one of the best-known Naval Air Reservists who was killed in action in 1942 aboard the USS Wasp (CV-7).

This huge book is a wonderful trip down memory lane, especially if you know anything about New England Naval Aviation, fleet and Reserve. Planes, places and people are at the heart of every page. Established in September 1941 near the town of Weymouth south of Boston, just north of the entrance to Cape Cod, NAS South Weymouth became the northeastern base for the Navy's fleet of airships that were necessary to provide protection against the growing threat of German U-boats prowling off the U.S. coast. The 1,257-acre tract was a desirable and accessible plot whose cost by the time the station opened had risen from $5 million to $6 million, nearly $100 million in today's inflated dollars.

The author spares no effort in telling the story of the air station and its role in U.S. preparation before entering World War II. With the sinking of the USS Reuben James (DD-245) on Oct. 31, 1941—and the loss of 115 of her 159 crewmen—and President Franklin Roosevelt repealing most of the Neutrality Act, construction of South Weymouth took on an important role. (If you are interested, find the popular folk song about the loss of the Reuben James, sung by "The Weavers.")

Frattasio describes the establishment of the blimp squadron (ZP) 11 in June 1942 and its patrols off the northeast U.S. coast. Rare photos complement the text, including of the station's iconic huge, black LTA (lighter-than-air) hangar that stood for many years until December 1966.

Postwar development, aircraft and the growth of the Naval Air Reserve in the northeast receive in-depth treatment. Photos of regular air shows in the 1950s display a wide panorama of cars and planes reminiscent of the events we see today at Navy air shows at MCAS Miramar, California; Joint Base Andrews, Maryland; NAS Norfolk and NAS Oceana, Virginia.

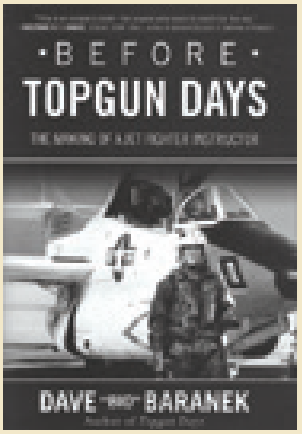
Occasional deployments fill the text, such as the U.S. response to the 1961 building of the Berlin Wall, which resulted in Naval Air Reserve mobilization that included SoWey's S2F and P2V anti-submarine warfare (ASW) squadrons. Information about the early Southeast Asia Reserve airlift, a program vital to the initial buildup in August 1964 in Vietnam, is among the most detailed I have seen and certainly fills in many gaps in the story.

The 1968 Pueblo Crisis and subsequent, disappointing recall of six NAR squadrons, which reorganized the Naval Air Reserve, are also discussed. New squadrons and aircraft changed the look of the South Weymouth Reserves.

The VP-MAU (Master Augment Unit) came along in January 1984 and it was an important development for the P-3 squadrons. As we go through the post-Korea period, SoWey became more focused on the ASW mission. Aircraft like the S-2, P-2 and P-3 flew from the station. (HS) 74 flew H-3 helicopters, but eventually became (HSL) 74 and transitioned to the SH-2 LAMPS helicopters.

South Weymouth also had an active Marine Corps Reserve presence and the author doesn't forget it. (VMA) 322 flew A-4s while (HML) 771's UH-1Es were busy as well.

This new book tells South Weymouth's story in full. The author has given himself a very large canvas on which to paint his equally large, wide-ranging account. He tells his story well. After all, he was there and knows his subject well.



Before Topgun Days, the Making of a Jet Fighter Instructor

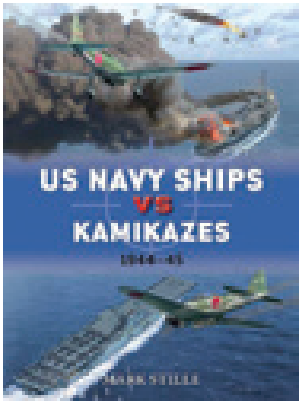
Dave "Bio" Baranek, Skyhorse Publishing, New York, NY. 2016. 190 pp. Ill. $22.99

Retired Cmdr. Dave "Bio" Baranek certainly enjoys writing about his flying experiences as an F-14 radar intercept officer (RIO). His first book, Topgun Days, from the same publisher was a popular account of his time in the fleet and more specifically as an instructor at the Navy's Fighter Weapons School, known as Topgun. He had the unusual experience as an advisor and participant in the 1986 blockbuster film "Top Gun," starring Tom Cruise. As one of the "bad guys" in sinister black two-seat F-5Fs, Baranek can point to himself in the climactic combat scenes at the end of the film.

In this prequel, he now revisits his time in the Training Command as a ROTC student at Georgia Tech, and then as a Student Naval Flight Officer (SNFO) at NAS Pensacola, Florida. He seems to have done fairly well in the tough, informational fire-hose courses at Training Squadrons (VT) 10 and 86, not to mention the post-winging F-14 Fleet Replacement Squadron (FRS), where there's no guarantee you'll keep those precious hard-won wings!

This is a short book, something that could be read in less than a beach weekend, but there's no denying that the path to Radar Intercept Officer (RIO) wings and your first fleet squadron is not an easy one. There are plenty of chances to excel as well as many boulders to trip over with disastrous results. A full career in a fleet fighter squadron, much less attaining squadron command, is a major life accomplishment that is cause for pride your entire life through. And while the author is confident and obviously skilled in his specialty, he is fully aware of how hard things can get some times in the air and on the ground.

Supplemented by a nice folio of mostly color photos taken by Baranek, himself an accomplished photographer, "Before Topgun Days" is a pleasant trip through a portion of a fighter guy's life that has not normally been offered to the outsider. If you've got money for the ticket, the ride might be worth the fee.



US Navy Ships vs Kamikazes 1944-45

Mark Stille, Osprey Publishing, New York and UK. 2016. 80 pp. Ill. $18

With this new addition to the successful Duel series, Osprey has now published three books dealing with the uniquely Japanese weapon of World War II, the Kamikaze aerial suicide pilots and their aircraft: one book in the Aircraft of the Aces series (no. 109), then another in the Vanguard series (no. 180), and this new book in the Duel series (no. 76). There appears to be a strange but profitable interest in this late-war group of mainly young men who, when asked, quickly volunteered to fly their planes of all types from biplane wooden trainers to front-line fighters and bombers into whatever surface target, mainly ships and hopefully aircraft carriers. Usually armed, or stuffed, with bombs and other explosives, not to mention their aircraft's fuel, these terrifying and incomprehensible (at least for their Allied opponents) methods of destruction achieved a large measure of havoc in the last year of the war in the Pacific.

There are examples of other nations' flight crews who, when faced with mortal wounds and heavy damage to their aircraft, and with no other way of accomplishing their mission, chose to dive into an enemy's ship or aircraft in a final act of supreme heroism, but the creation of specific units whose only mission was to do this specific thing—with the possible exception of German Luftwaffe groups being planned at the end of the war in Europe—is something that can only be found in the extreme nationalist mindset of the Japanese military at the end of the obviously lost war. One could arguably include modern suicide bombers from the Middle East-including those who hijacked the four American airliners on Sept. 11—as part of this extreme tradition.

Mark Stille, a retired U.S. Navy commander, describes the formation and early sorties by kamikaze units in the Philippines and then the devastating attacks during the Okinawa campaign from April to July 1945 as the war drew to a close. Graphics include cockpit layouts of Japanese aircraft, mainly Zeros as they were the most used suicide types, armament layouts (including bombs and internal guns), and maps. An interesting map—with a subject I have never seen before—shows the many radar picket stations around Okinawa, manned usually by American destroyers that often took the brunt of kamikaze raids that couldn't get through to the larger ships like battleships, cruisers and carriers.

The author delves into the personalities, the ethos of the young Japanese pilots seeking to strike one last important blow against Allied surface ships. The ships fought back with their array of ship-mounted AA artillery while the carriers launched the latest fighters, including late-model Hellcats and Corsairs.

The small rocket-powered manned rocket bomb known as the Baka, which was carried by modified Mitsubishi G4M land-based bombers is well detailed. There is also surprising information on the A6M7 variant of the Zero, which is unexpected as that was one of the last models of the legendary fighter to see action.

A number of photos round out the graphic selection that make this book an important addition to Osprey's latest lineup.

Squadron Spotlight

Helicopter Maritime Strike Squadron (HSM) 46 "Grandmasters"

Established: April 7, 1988

Based: Naval Station Mayport, Florida

Current Commanding Officer: Cmdr. Chris A. Richard

Mission(s): *Surface Warfare (ASUW), Anti-Submarine Warfare (ASW), Command and Control (C2), Search and Rescue (SAR)*

Brief History: The title "Grandmaster" is bestowed on those who achieve international standing in the game of chess through demonstrated tactical expertise and precision execution. The professionals of HSM-46 are dedicated to those same ideals, and they possess the same commitment to excellence—thus, the squadron's moniker and its insignia.

Since its establishment in 1988 as Helicopter Anti-Submarine Squadron Light (HSL) 46, when its crews flew the venerable SH-60B Seahawk helicopter, the Grandmasters remain the longest standing Expeditionary HSM squadron on the East Coast. In 2012, the squadron was re-designated HSM-46 when it transitioned to the state-of-the-art MH-60R Seahawk. HSM-46 currently deploys up to six detachments aboard Atlantic Fleet ships in support of Combatant Commander requirements around the world.

MH-60R employment draws from the model established by the Light Airborne Multi-Purpose System (LAMPS) program and its Mk I (SH-2 Seasprite) and Mk III (SH-60B Seahawk) predecessors. It is designed to combine the capabilities of cruiser-destroyer sensors with those of the helicopter to provide early detection, prosecution and engagement of enemy surface and subsurface contacts. The Grandmasters continually push the MH-60R to its operational limits, taking full advantage of its diversified and specialized combat capabilities.

In 2010, following the devastating earthquake in Haiti, HSL-46 flew out of Port-au-Prince International Airport and from USS Normandy (CG 60) distributing relief supplies across the Haitian countryside. Crews transported 58 people to shore-side medical facilities.

In a 2014 deployment aboard USS Halyburton (FFG 40), HSM-46 received a distress call from a downed Panamanian helicopter and conducted a night search-and-rescue operation deep in the Panamanian jungle; working alongside Panamanian assets, HSM-46 extracted six wounded from the crash site. In 2015, while transiting the Straits of Gibraltar, an HSM-46 aircraft was conducting a surface search, surveillance and control mission from Normandy when the aircrew discovered a rigid hull inflatable boat involved in illicit-trafficking. The Normandy recovered more than 1,200 pounds of heroin that was valued at more than $111 million.

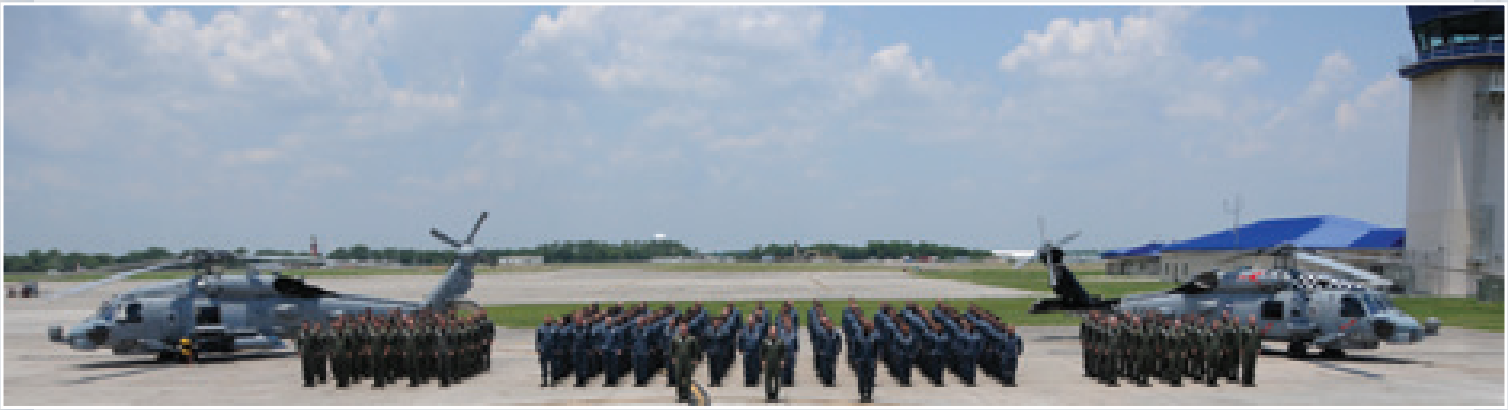
HSM-46 has repeatedly demonstrated its tactical expertise and its value in the deployed maritime environment. Whether supporting the carrier strike group (CSG) or flying from small ships in the littorals, the men and women of HSM-46 will continue to "set the standard" like generations of Grandmasters before them.

Aircraft Flown: MH-60R

Number of People in Unit: 258 military personnel

Significant Accomplishments:

- **First East Coast HSM expeditionary squadron to provide sole HSL/HSM support to a deployed CSG—USS Theodore Roosevelt CSG 2015-2016**
- **Nine Battle "E" awards**
- **Seven "Golden Wrench" awards**
- **2016 Arnold J. Isbell Trophy for ASW/ASUW Excellence**
- **2016 CNO Aviation Safety Award**
- **2016 Retention Excellence Award**



U.S. Navy photo

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