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WW II Aircraft Flies Again for NAWCAD Telemetry

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A rebuilt airplane that first took off before D-Day is flying again for the Naval Air Warfare Center Aircraft Division (NAWCAD), this time equipped with a first-of-its-kind advanced airborne telemetry antenna—a digitally controlled, phased-array system that can track multiple targets at the same time.

Originally manufactured in 1944 at the Oklahoma City Douglas Aircraft plant, the reborn C-47—the military version of the DC-3 passenger and cargo plane—has been almost completely rebuilt for telemetry. The upgraded aircraft, now called the BT-67, has several advantages over the modern aircraft that normally carry flight test instruments for NAWCAD's Atlantic Ranges and Targets (ART) Department at Naval Air Station Patuxent River, Maryland. The BT-67 supports the East Coast test and training missions of ART's Atlantic Test Ranges (ATR) and Atlantic Targets and Marine Operations.

"More interior space, much greater tracking range and longer endurance," said Dennis Normyle, ART chief architect. "It can stay 8 to 10 hours on station, a significant increase over typical range aircraft."

At first glance, this might be a DC-3 heading toward occupied France to drop paratroopers behind Wehrmacht lines. But the sleek turboprop engines, telemetry antenna pod on the belly, smaller antennas bristling from the fuselage and chin-mounted weather radar identify it as a modern BT-67 equipped for ART test flight support.

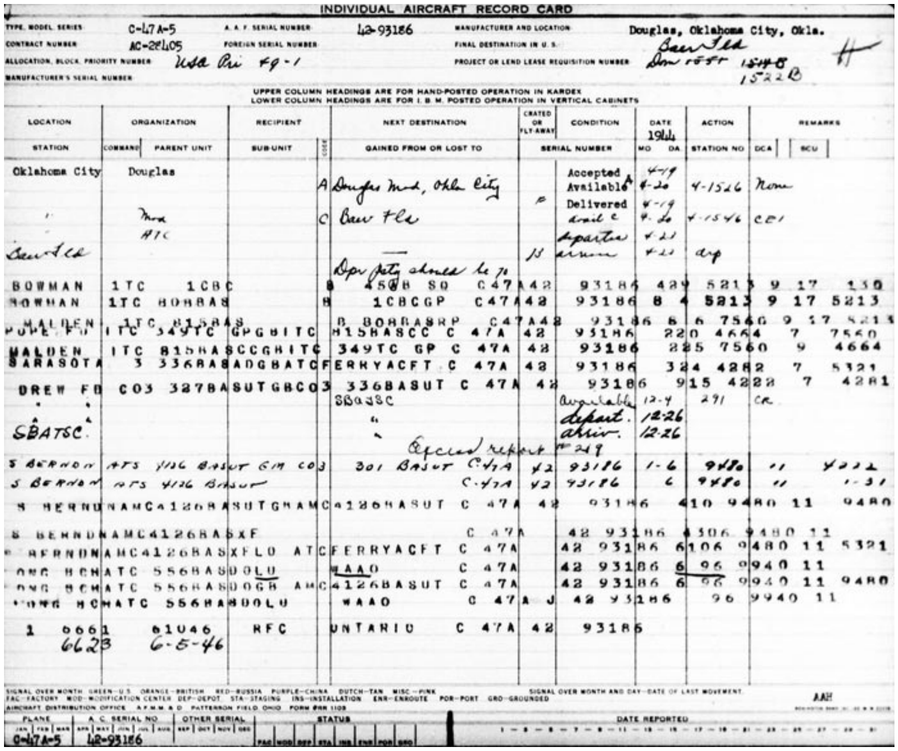
The RAPTR telemetry antenna fills the aircraft nose. The weather radar formerly located here has been moved to the bulbous chin housing below.

Owned and operated by AIRTec, Inc., of California, Maryland, the BT-67 supports offshore testing beyond the reach of land-based facilities. The aircraft relays telemetry, communications, video, flight termination and GPS signals back to ATR's land facilities and records all data onboard as well.

"Since it's flying at altitude, it can relay signals from a test aircraft far over the horizon," said Dan Skelley, lead engineer for the project.

Besides traditional open-air testing with ATR's Real-Time Telemetry Processing System, the aircraft serves as a platform for tactical data links such as Link 16, Joint Tactical Radio System (JTRS) and Tactical Target Networking Technology (TTNT), said Brady Lesko, AIRTec's director of telemetry programs and safety. "We can be a relay node between aircraft, ships and ground installations for fleet exercises, and we can feed data we've collected into the network as well."

The BT-67 is equipped with Federal Aviation Administration-approved racks, power supply and antenna hookups needed for data-processing and transmission equipment along with plenty of space for control station consoles and the people to operate them.



INDIVIDUAL AIRCRAFT RECORD CARD

TYPE, MODEL, SERIES C-47A-5 | A. A. F. SERIAL NUMBER 42-93186 | MANUFACTURER AND LOCATION Douglas, Oklahoma City, Okla.
CONTRACT NUMBER AC-28405 | FOREIGN SERIAL NUMBER | FINAL DESTINATION IN U. S.
ALLOCATION, BLOCK, PRIORITY NUMBER | PROJECT OR LEND LEASE REQUISITION NUMBER
MANUFACTURER'S SERIAL NUMBER

UPPER COLUMN HEADINGS ARE FOR HAND-POSTED OPERATION IN KARDEX
LOWER COLUMN HEADINGS ARE FOR I. B. M. POSTED OPERATION IN VERTICAL CABINETS

LOCATION / STATION | ORGANIZATION / COMMAND, PARENT UNIT | RECIPIENT / SUB-UNIT | CODE | NEXT DESTINATION / GAINED FROM OR LOST TO | CRATED OR FLY-AWAY | CONDITION / SERIAL NUMBER | DATE 1944 / MO DA | ACTION / STATION NO | REMARKS / DCA, SCU

Oklahoma City | Douglas | | | | | Accepted 4-19 | Available 4-20 | Delivered 4-19

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BOWMAN 1TC 808BAS 8 1CBCGP C47A 42 93186 8 4 5213 9 17 5213
MALDEN 1TC 815BAS B 808BASRP C47A 42 93186 6 6 7560 9 17 5213
POPE FD 1TC 349TC GPGBITC H15BASCC C 47A 42 93186 2 20 4664 7 7560
MALDEN 1TC 815BASCCGBITC 349TC GP C 47A 42 93186 2 25 7560 9 4664
SARASOTA 3 336BASADGBATCFERRYACFT C 47A 42 93186 3 24 4282 7 5321
DREW FD C03 327BASUTGBC03 336BASUT C 47A 42 93186 9 15 4228 7 4281
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6623 6-5-46

SIGNAL OVER MONTH: GREEN—U.S. ORANGE—BRITISH RED—RUSSIA PURPLE—CHINA DUTCH—TAN MISC—PINK | SIGNAL OVER MONTH AND DAY—DATE OF LAST MOVEMENT
FAC—FACTORY MOD—MODIFICATION CENTER DEP—DEPOT STA—STAGING INS—INSTALLATION ENR—ENROUTE POR—PORT GRO—GROUNDED
AIRCRAFT DISTRIBUTION OFFICE A.F.M.M. & D. PATTERSON FIELD OHIO FORM ### 1108
PLANE C-47A-5 | A. C. SERIAL NO 42-93186 | OTHER SERIAL | STATUS | DATE REPORTED

Original aircraft record card for C-47 model number 42-93186 that became ART's new BT-67. Although difficult to decipher, it contains a complete list of its destinations and dates until it ended up in Ontario, Canada, on June 5, 1946.

Recent and upcoming test exercises include:

- Integration and initial ground testing of a workstation/data-management console for the SPN-41 and SPN-46 landing systems. The capability enables real-time, in-flight data analysis for at-sea testing of landing systems for aircraft carrier and landing helicopter assault ships.
- A data relay event integrating a JTRS and TTNT terminal to link multiple airborne and surface nodes with each other and NAWCAD's Surface-Air Interoperability Lab at Pax River.
- Upcoming Combat Ship Systems Qualification Test events at the Surface Combat Support Center at the NASA Wallops Flight Facility in Virginia. A new payload will allow Link 16 connectivity between test conductors and AEGIS surface combatants under test.
- SM-6 missile surrogate testing at the White Sands Missile Range to help quantify the BT-67's digitally controlled, phased-array telemetry antenna for future off-shore testing events.

The BT-67's unique telemetry antenna was designed and built by Raven Defense, Albuquerque, New Mexico, to ART's specifications. Known as the Raven Advanced Phased-Array Telemetry Resource (RAPTR), it's the first of its kind ever installed in an aircraft, Skelley said. "It's a hybrid system with analog signals under digital control."

Modern turboprop engines take the place of the radial piston engines that powered the C-47 and DC-3. The fuselage was lengthened 42 inches directly behind the cockpit for more interior space and to keep the crew compartment ahead of the new propellers on the turboprop engines, which extend farther forward than the old piston engines.

The antenna consists of numerous tiny receiver elements installed in the aircraft nose. "The control system varies the timing, or phase, of the elements' outputs and combines them in a way that allows the antenna to

One of the BT-67's big advantages for test support is the roomy interior, with plenty of space for equipment consoles and people to operate them.

track up to three targets," he said.

The BT-67 also carries a legacy flat-panel array antenna mounted in a belly pod. The unit can track a single telemetry source by mechanically turning to follow a target in flight.

The combination of a phased-array and flat-panel antenna triples the tracking capability of ART's standard King Air range support aircraft, which carries only a single flat-panel antenna. "With the older antenna we have to make a decision: which signal to follow—one weapon or one target," Normyle said. "Now we can follow three individual telemetry frequencies. For example, we can track an F-18 firing a missile, the missile itself, and the missile's target all at the same time. Future upgrades will expand that number."

Direct project funding helped pay for the antennas and mission support consoles. AIRTec purchased the airplane and is responsible for all flight operations, storage and maintenance, Lesko said.

"We only pay when we use it," ART's Normyle said. "It's a simple fee-for-service."

Basler Aircraft of Oshkosh, Wisconsin, builds the BT-67 from old DC-3s and C-47s. "They scour the world for ones in rebuildable condition," Skelley said. The aircraft ART uses is a rebuilt U.S. Army Air Forces C-47 used for training during World War II.

But the wartime roles of DC-3s and C-47s extended far beyond training. C-47s towed gliders and dropped paratroopers behind German lines on D-Day. And C-47s and DC-3s flew supplies during the war over the stormy Himalayas, "the hump," from India to China to fight the Japanese. The versatile aircraft also flew resupply missions for the Berlin airlift during the post-war Soviet blockade.

Supreme Allied Commander General Dwight Eisenhower said the C-47 was one of the four pieces of equipment most important for winning World War II, along with the bulldozer, jeep and two-and-a-half-ton truck. "Curiously, none of these is designed for combat," he noted.

For its modern reincarnation, Basler completely reskins the aircraft, lengthens the fuselage 42 inches between the cockpit and wings, and replaces most of the longitudinal stringers and other structural members. The reborn BT-67 also sports a digital instrument panel—a "glass cockpit"—additional fuel tanks in the wings, and two turboprop engines in place of the old radial piston power plants.

"The Federal Aviation Administration considers it a new airplane," said Lesko, a former airline and charter pilot. "About all that's left is the wing support structure that passes through the fuselage and the landing gear."

The new BT-67 also improves on the endurance, range, and cargo capacity that once made the piston-engine DC-3s and C-47s the most popular airplanes in the world. On the eve of World War II, DC-3 flights made up 90 percent of international air traffic.

Taking cost effectiveness into account, Lesko said, the updated BT-67 is superior to any modern aircraft for ART's T&E and training support mission.

"It's very stable and can fly at a slow speed that makes it easier to stay in a designated test area," he said. "You can do 89 knots (92 mph) all day long."

The large, old-fashioned tail rudder provides another advantage over modern aircraft, he said. "The plane can make flat 'skid' turns with the rudder that keep the wings level. With a conventional banking turn, one wing drops down and can block telemetry signals from reaching the antenna."

And even with all this capability, it's comparatively

The BT-67 has a new digital "glass cockpit" in place of the old C-47 panel.

cheap to operate, Lesko said. He estimates it's less than one-fifth the cost of a similarly outfitted P-3 maritime patrol aircraft and one-fourth the cost of a Dash 8, a medium-size turboprop passenger aircraft.

"Greater endurance, longer range, roomy, slow and cheap," he said. "Douglas couldn't have built a better platform for telemetry — with modern upgrades, of course. It may not seem possible that a plane designed in the 1930s could be superior to modern aircraft for this range support mission. But it's ideal for the role, even though it doesn't look much different from the ones that were flying 85 years ago." ❑

BOB KAPER is senior technical writer for the Atlantic Ranges and Targets Department at Naval Air Station Patuxent River, MD. A former journalist and TV/video producer in Washington, DC, Bob has worked for the Naval Air Systems Command at Pax in multiple communications roles since 2005.