An E-3 AWACS on the ramp at McChord AFB, Wash. So far, USAF has upgraded nine of 27 AWACS aircraft to Block 40/45, completely modernizing how air battle managers process sensor data.

The E-3 Sentry Airborne Warning and Control System has flown continuously in the Middle East for more than 20 years, but its most recent deployment is the most notable since the aircraft began watching Iraq in the early 1990s.

On Nov. 18, an E-3G—the first AWACS outfitted with the Block 40/45 upgrade to deploy—landed at a base in Southwest Asia, complete with brand-new overhaul of the cockpit and mission control systems. The aircraft went to war utilizing large-scale upgrades that come at a cost of $2.7 billion for mission computing and communications, to handle a new generation of air warfare.

For the E-3 itself, "the airframe will fly well into the 2030s," said Col. Patrich Skendziel, the division chief of C2 weapon system requirements for Air Combat Command, in an interview with *Air Force Magazine.* "It's been maintained very, very well throughout its lifespan. ... Plus we bought the airplanes

brand-new when we initially bought them, so now it's just a matter of keeping the airplane viable as technology evolves."

As of November, nine of the 27 E-3s at Tinker AFB, Okla., had received the Block 40/45 upgrades with crew certification. The service flies four more AWACS aircraft, with two assigned to Kadena AB, Japan, and two at JB Elmendorf-Richardson, Alaska.

The Block 40/45 system reached initial operational capability in June 2014 and was immediately put through the paces at Red Flag at Nellis AFB, Nev., in August and at exercise Northern Edge 2015 over the Joint Pacific Alaska Range Complex near Elmendorf. In Alaska, two E-3Gs from the 964th and 966th Airborne Air Control squadrons surveyed and controlled almost 100 fighters and bombers in a 300-mile radius, according to an Air Force news release on the exercise.

"It provides more situational awareness," said 1st Lt. Breann Hermann, a 964th AACS air weapons officer, in the release.

AWACS For the 21st Century

By Brian W. Everstine, **Pentagon Editor**

USAF's E-3 fleet is now deployed with its biggest upgrade ever.

USAF photo by SSgt. Jacob Bailey

"You can personalize it, and now you can build unlimited airspaces. It's more reliable and more technologically advanced."

READY FOR WAR

The jet flew 15 command and control missions during the exercise in Alaska, testing and honing the advanced equipment onboard. The E-3s that took part in the exercises performed well, giving the service confidence to move forward on its long-planned deployment of the upgraded jets to the Middle East. The AWACS, in the exercises, performed "well enough to get into the combat theater," even years before the fleet reaches full operational capability, Skendziel said.

"Deploying to the combat theater is the culmination of many hard hours, learning and building standard operating procedures to execute the mission in any combat or contingency environment," said Col. David M. Gaedecke, commander of the 552nd Air Control Wing at Tinker. "What the E-3 brings

to the fight is essential to our combat commanders, both in the air and on the ground."

The Air Force began testing the E-3 Sentry in October 1975, taking a Boeing 707/320 commercial aircraft straight from the production line and outfitting it with the massive 30-foot-wide radar dome, along with mission control systems in the cabin for up to 19 specialists. Shortly after the first E-3s were delivered to Tinker in 1977, the aircraft began flying missions at home and in operations abroad.

These missions ranged from small operations in Grenada to air wars in Yugoslavia, Iraq, and Afghanistan, with the aircraft proving it can deploy quickly to help set up an air campaign overseas. The AWACS and their crews deployed constantly in the years since the E-3 entered the fleet, using a massive radar to track and control US and allied aircraft in all weather and providing a real-time picture of battlespace to a joint air operations center.

During flight, the jet tracks everything in its area—both friendly and hostile activity—and helps to provide location information for aircraft.

Decades after the Air Force began flying its E-3 fleet, the service used the same commercial frame for a new fleet, the E-8C Joint Surveillance Target Attack Radar System. Air Force officials have recently said the lack of a Boeing 707 production line and dwindling parts is a reason the service needs to move forward and replace the E-8s with a new commercial aircraft.

Some of the 707s were heavily used as "cattle cars" before the service bought them in the 1990s for conversion, and since then costs have grown too burdensome to continue to fly, Air Force Chief of Staff Gen. Mark A. Welsh III said in September at the Air Force Association's Air & Space Conference. Combatant commanders have all agreed that now is the time to move away from the 707 frame for the JSTARS mission, Welsh said.

However, the E-3 fleet has remained comparatively healthy and will be able to fly safely longer into the future. The jet needs technological upgrades to stay viable, as opposed to service-life extensions and engine replacements that would be needed for a less healthy fleet. In Fiscal 2015, the upgraded E-3G fleet saw a mission capable rate of 82 percent, with the service's E-8C fleet lagging behind at 76 percent. But it is not just an issue of the health, it's the scattered past of the E-8 fleet that is the cause of its hazy future, Skendziel said.

"When the JSTARS were bought, they were actually purchased with a lot of service life already used up, and they came from a bunch of different areas, a bunch of different airlines and the maintenance records that came with them weren't always that complete," he said. "We've struggled with determining what is the life cycle of those airplanes."

The E-3 707s, on the other hand, were brand-new when USAF acquired them, "and the Air Force has held the maintenance and sustainment responsibility and program on that throughout its lifecycle, so we've had very, very good control of how well those airplanes have been maintained," Skendziel said.

The Air Force, beginning in 2003, sought to replace both the E-3 and E-8, along with the RC-135 Rivet Joint, with a common airframe, referred to as the E-10. The new multimission aircraft would take over the E-3's air-to-air control operations, along with air-to-ground and intelligence collection. The service began the program with a $215 million contract to a team of Northrop Grumman, Boeing, and Raytheon for development of a new aircraft based on a more modern Boeing 767.

The program was canceled in February 2007 during budget cutbacks as it grew too complex.

The service has since moved forward on its JSTARS recapitalization, looking to award a contract for 25 aircraft to be delivered by 2023, but today's plans call for upgrades to the existing E-3 airframes as the preferred path for future airborne warning and control.

The Air Force began testing the $2.7 billion Block 40/45 upgrades in 2006, with the program entering low-rate production three years later. While components of the aircraft were modified in the late 1990s, the current upgrade marks the largest overhaul of the AWACS fleet since it was first delivered.

"This modification represents the most significant upgrade in the 35-plus-year history of the E-3 and greatly enhances our crewmembers' ability to execute the command and control mission, while providing a building block for future upgrades," said Gaedecke, the commander at Tinker, in a release when the aircraft deployed in November.

LOST IN TRANSLATION

In 1999, the AWACS went through a joint US and NATO program to improve its radar system and install radar electronic countermeasures. The upgrade program is a partnership between the 552nd Air Control Wing at Tinker; the E-3 System Program Office at Hanscom AFB, Mass.; the Oklahoma City Air Logistics Complex; and prime contractor Boeing that aims to turn around five E-3s per year. The depot cycle and upgrades are "meticulously" programmed so

USAF photo by SSgt. William Banton

USAF photo

SSgt. Greg Pfeffer, an AWACS flight engineer, after a mission during Exercise Northern Edge in June. The E-3G surveyed and controlled almost 100 fighters and bombers in a 300-mile radius during the exercise.

Air Combat Command can maintain its deployment schedule, Skendziel said.

The hardware onboard the Air Force's older E-3 fleet dates to when it started flying in the late 1970s, and while the massive radar brings in copious amounts of data, crews onboard were limited by old computers' ability to translate that information.

The upgrade is like moving from "an Atari to an Xbox" game system, completely modernizing how air battle managers handle sensor data. The aircraft's systems process information with a much higher capacity and at a faster rate, both simplifying the work onboard and increasing the output. That means more efficient control on a mission and simplified training at home because the human-machine interface is "so much more intuitive," Skendziel said.

"It takes the same amount of sensor data that was coming into the airplane before the upgrade and it allows the crew to translate that information and then to turn it out and put it out over either the radios or the data links to the joint air component at a much higher capacity and at a much faster rate," he said. "It has really sped up the tempo on the better battle management that the E-3 crews can now produce."

Part of the Block 40/45 upgrade is replacing the aircraft's interrogation system and modern Link 16 radios. The upgrades are driven by AWACS' requirement to keep up with the jets it controls, as the service brings in more fifth generation fighters.

The first new interrogation system was installed at Hanscom in July, with the modern AN/UPX-40 system expected to improve an AWACS' ability to track low-flying aircraft by eliminating ground clutter signals that have confused other radars. The $60 million contract, awarded to Telephonics Corp., began delivery in 2015, with all 31 Air Force E-3s slated to receive the new system.

"The UPX-40 dramatically improves the detection of weak signals or maneuvering targets at maximum range and improves detection of targets at all ranges," said Nick Grudziecki, the deputy program manager of the AWACS Next Generation Identification Friend or Foe office at Hanscom,

in a release announcing the first installation. "The new interrogation capabilities also provide faster detection of friendly targets."

While the Block 40/45 upgrades are installed, the service is working with the NATO E-3 fleet on an avionics upgrade system called DRAGON to move to a modern glass cockpit. The $1.4 billion program will replace the aircraft's 40-year-old avionics with modern digital instrument displays and subsystems that meet requirements from the Federal Aviation Administration and the International Civil Aviation Organization to "keep the airframe viable in all airspaces around the world," Skendziel said.

These upgrades, with a planned initial operational capability date of 2021, streamline operations enough that it will allow the service to eliminate the navigator position, lowering the required crew size from four to three, according to the Air Force.

The cockpit upgrades will also include a weather radar that predicts wind shear, an enhanced ground proximity warning system, improved engine warnings, a digital flight deck audio distribution system, and crew alert system, according to the DRAGON program office release at Hanscom.

The jet has been flying continuously in the Middle East for more than two decades—rotating from its home station in Oklahoma to bases throughout Southwest Asia, while still constantly being called on for homeland protection and humanitarian missions. The plan for the most recent deployment wasn't made in response to Operation Inherent Resolve, though the jet will stay busy flying in support of the aircraft targeting ISIS in Iraq and Syria.

Despite the new systems on the E-3 fleet, the mission isn't new.

"The E-3 has been in the desert since well before 9/11," Skendziel said. "We were flying Northern Watch and Southern Watch out of Turkey and Saudi Arabia. … That's actually something some of the joint services don't always recognize, that the AWACS and the Air Force [have] been in the desert since ... the first Gulf War." ✪
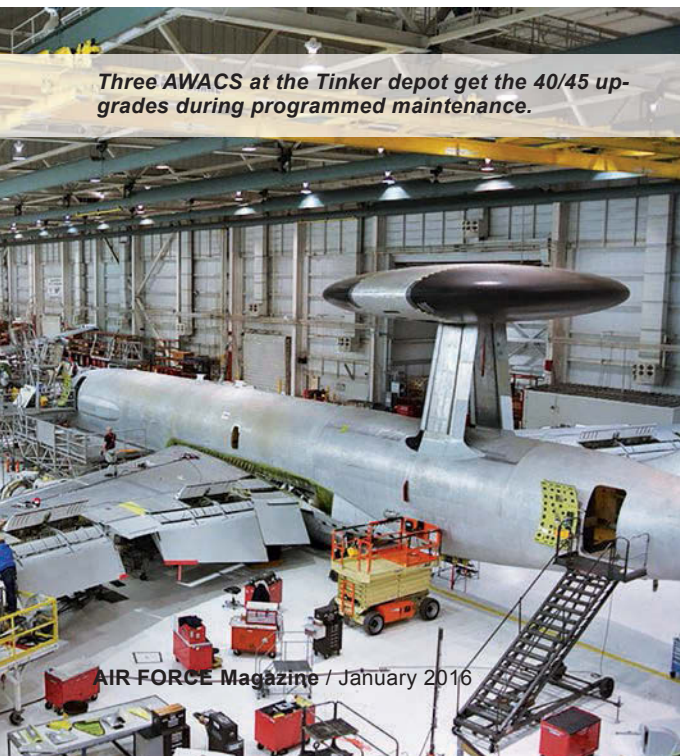
Three AWACS at the Tinker depot get the 40/45 upgrades during programmed maintenance.

USAF photo by SSgt. William Banton

SSgt. Daniel Van Horn, an AWACS E-3G surveillance technician, prepares for a mission above Alaska during Northern Edge.