

## KC-46A

### Executive Summary

- The KC-46 program completed all planned flight test events necessary for the Federal Aviation Administration (FAA) Aircraft Amended Type Certificate of the Boeing 767-2C aircraft in July 2017. A few remaining flights are expected to satisfy FAA requirements during the final review process. The program is continuing to accomplish FAA Supplemental Type Certificate test events to complete FAA certification of the KC-46A aircraft.
- Flight testing to certify the aerial refueling (AR) system and the first eight aircraft for receiver operations with the KC-46A began in October 2017.
- Electromagnetic pulse (EMP) testing was not accomplished in accordance with the DOT&E-approved Test and Evaluation Master Plan (TEMP) and the LFT&E Strategy. While testing indicated the KC-46A flight-critical systems and boom refueling systems are likely survivable to the 6 decibel (dB) contractual requirement, the Program Office approved verification plan did not demonstrate the residual KC-46A mission systems capability during such an event.
- IOT&E is likely to start in January 2019 or later. Schedule analysis identified two key milestones affecting IOT&E start: (1) completion of AR certification of the initial group of three receivers before the beginning of operational aircrew training and (2) certification of all 18 receivers planned to participate in operational test by the mid-point of IOT&E.
- Analysis of boom AR testing to date showed a significant number of instances where the boom nozzle contacted the receiver aircraft outside the refueling receptacle and in many of those instances, the Aerial Refueling Operators (AROs) were unaware those contacts had occurred. Boom nozzle contact outside the receptacle can damage antennae or other nearby structures, but is especially problematic for low-observable receiver aircraft by damaging radar-absorbing coatings. A potential contributing factor for both the number of contacts outside the receptacle and undetected contacts is the reduced visual acuity of the AROs using the remote vision system. Boeing and the Air Force teams are conducting root cause analysis, reviewing the historical data, and will be collecting additional data during upcoming tests.

### System

- The KC-46A AR aircraft is the first increment of replacement tankers (179) for the Air Force's fleet of more than 400 KC-135 tankers.
- The KC-46A design uses a modified Boeing 767-200ER commercial airframe with numerous military and technological upgrades, such as the fly-by-wire refueling boom, the remote ARO's station, 787 cockpit, additional fuel tanks in the body, and defensive systems.



- The KC-46A will provide both a boom and probe-drogue refueling capabilities. The KC-46A is equipped with an AR receptacle so that it can also receive fuel from other tankers, including legacy aircraft.
- The KC-46A is designed to have significant palletized cargo and aeromedical capacities; chemical, biological, radiological, and nuclear survivability; and the ability to host communications gateway payloads.
- Survivability enhancement features are incorporated into the KC-46A design.
  - Susceptibility is reduced with an Aircraft Survivability Equipment suite consisting of Large Aircraft Infrared Countermeasures (LAIRCM), a modified version of the ALR-69A Radar Warning Receiver (RWR), and a Tactical Situational Awareness System. The suite is intended to correlate threat information from pre-flight planning, the RWR, and other on- and off-board sources and to prompt the crew with an automatic re-routing suggestion in the event of an unexpected threat.
  - Vulnerability is reduced by adding a fuel tank inerting system and integral armor to provide some protection to the crew and critical systems.

### Mission

Commanders will use units equipped with the KC-46A to perform AR to accomplish six primary missions to include nuclear operations support, global strike support, air bridge support, aircraft deployment, theater support, and special operations support. Secondary missions will include airlift, aeromedical evacuation, emergency AR, air sampling, and support of combat search and rescue.

### Major Contractor

The Boeing Company, Commercial Aircraft in conjunction with Defense, Space & Security – Seattle, Washington

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## Activity

- The KC-46 program completed all planned flight test events necessary for the FAA Aircraft Amended Type Certificate of the Boeing 767-2C aircraft in July 2017. A few remaining flights are expected to satisfy FAA requirements during the final review process. The program is continuing to accomplish FAA Supplemental Type Certificate test events to complete FAA certification of the KC-46A aircraft.
- The program is now accomplishing testing using the production-representative version of last year's redesigned prototype boom.
- Flight testing to certify the AR system and the first eight aircraft for receiver operations with the KC-46A began in October 2017.
- The KC-46A deployed to Fairbanks, Alaska, for cold weather testing in January 2017 and then to Yuma, Arizona, for hot weather testing in August 2017. The program had planned to accomplish additional cold weather testing in the McKinley Climactic Laboratory at Eglin AFB, Florida, in September 2017 but decided not to accomplish testing at that venue due to the threat of hurricanes. The program is planning on accomplishing those additional tests in December 2017 in Alaska.
- Boeing completed Block 20 LAIRCM flight testing at Moses Lake, Washington, in 2017 to confirm installed system performance.
- The Navy conducted EMP testing at Naval Air Station, Patuxent River, Maryland, in July 2017 on behalf of Boeing. Testing was not accomplished in accordance with the DOT&E-approved TEMP and the LFT&E Strategy. Testing demonstrated KC-46A flight critical capabilities were still available after exposure to a 6 dB pulse; however, testing did not fully demonstrate AR capabilities as required. The program uninstalled or deactivated multiple mission critical systems prior to testing and, therefore, their EMP tolerance was not tested on an aircraft in a mission-representative configuration. Additionally, the testing did not demonstrate the function of the AR boom and the wing AR pods following an EMP event to show the KC-46A can perform the required missions.
- The Air Force plans to complete two nuclear threat-focused assessments for the KC-46A in FY18: (1) assess the ability to launch and fly a safe distance from a simulated nuclear attack to a KC-46A staging base, and (2) assess the KC-46A's inherent nuclear hardness to blast, radiation, flash, thermal, and EMP effects. Requirements resulting from proprietary data agreements have hindered the start of these activities.
- The Program Office coordinated with Boeing for access to a production-representative KC-46A for a Cybersecurity Vulnerability Assessment (the second cybersecurity vulnerability assessment during developmental testing) in May 2017. The program will use the classified results to inform continued software updates and cybersecurity testing during operational tests.

## Assessment

- IOT&E is likely to start in January 2019 or later. Schedule analysis identified two key milestones affecting IOT&E start: (1) completion of AR certification of the initial group of three receiver aircraft before the beginning of operational aircrew training and (2) certification of all 18 receiver aircraft planned to participate in operational test by the mid-point of IOT&E. DOT&E concurs with the initial program plan requiring these 18 receiver aircraft as necessary to support an adequate IOT&E of a new Air Force tanker.
- Analysis of boom AR testing to date showed a significant number of instances where the boom nozzle contacted the receiver aircraft outside the refueling receptacle and in many of those instances, the AROs were unaware those contacts had occurred. Boom nozzle contact outside the receptacle can damage antennae or other nearby structures, but is especially problematic for low-observable receiver aircraft by damaging radar-absorbing coatings. A potential contributing factor for both the number of contacts outside the receptacle and undetected contacts is the reduced visual acuity of the AROs using the remote vision system. Boeing and the Air Force teams are conducting root cause analysis, reviewing the historical data, and will be collecting additional data during upcoming tests. Without an appropriate solution, this problem will have adverse operational mission effects on low-observable aircraft at a minimum.
- EMP testing was not adequate to assess whether the KC-46A is mission capable to the contractually required 6 dB design margin based upon Military Standard (MIL-STD) 464. The program powered down or removed critical mission systems that were not required to meet the threshold Key Performance Parameter requirement including radios, satellite communications, weather radar, RWR, LAIRCM system, and the wing AR pods for this test. The program pre-deployed the refueling boom with hydraulics deactivated for the EMP test and therefore the capability to deliver fuel during or immediately following the EMP event was not tested. No test was performed with all flight and mission systems on, which is required to provide a representative load to the system under EMP conditions.
- The KC-46A EMP design margin was based on MIL-STD 464 and the threat defined in MIL-STD 2169. After the fixed-price contract was awarded, the DOD instituted a new MIL-STD 3023 that requires tanker aircraft supporting the nuclear deterrent mission to meet a 20 dB EMP design margin versus the contractually required 6 dB EMP design margin. Unless additional tests are resourced, the Air Force or U.S. Strategic Command will not know if the KC-46A meets the 20 dB EMP hardening requirement in MIL-STD 3023.
- Boeing and the Air Force still need to complete several tests that assess areas that significantly influence the aircraft's survivability. These include flight testing of the On-Board Inert Gas Generation System and thermal testing of the nuclear flash curtains.

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- LAIRCM testing provided hit point distribution data to inform the vulnerability assessment and to verify that LAIRCM performance on the KC-46A has not been degraded from previously demonstrated performance on other aircraft. The evaluation included both system configurations (Block 20 with ultraviolet missile warning system and Block 30 with two-color infrared missile warning system).

## Recommendations

- Status of Previous Recommendations. The Air Force has addressed all FY12 through FY14 recommendations. The Air Force still needs to address the following FY15 and FY16 recommendations:
    1. Ensure all AR receiver aircraft are certified for use by operational aircrew early enough in IOT&E to permit sufficient operational testing.
2. In conjunction with U.S. Strategic Command, determine whether its personnel can conduct the nuclear deterrence and strike missions with a KC-46A only having 6 dB EMP shielding as per the contract. If additional EMP shielding is deemed necessary, the Air Force should conduct testing as part of FOT&E to determine the actual KC-46A EMP design margin.
  3. Develop an executable schedule that is based on program demonstrated-to-date fly and re-fly rates.
- FY17 Recommendation.
    1. The Air Force should re-test the KC-46A in an operationally representative condition to determine the actual EMP design margin. Demonstrate the function of the AR boom and the wing AR pods following an EMP test to show the KC-46A can perform the required missions.

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