

The Tanker *Nears* **TAKEOFF**

By John A. Tirpak, Executive Editor

After more than a decade of fits and stops,
USAF's next tanker is almost here.

A Boeing artist's illustration of a KC-46A refuelling a B-2 bomber.

Boeing illustration



This month, what will be the first new-build Air Force strategic tanker in 25 years will roll out of Boeing's Everett, Wash., plant: the first of four aircraft that will comprise the KC-46 test force. While USAF's 12-year journey to the milestone has been politically harrowing, so far the technical program is making solid progress and is expected to deliver the urgently needed aircraft at the time and price promised.

"We think Boeing has a greater than 90 percent probability of meeting RAA—which is required assets available—18 aircraft by August of '17," said Maj. Gen. John F. Thompson, USAF's program executive officer for tanker programs, in an October interview. The schedule risk assessment, he said, was made in May. Since then, the KC-46 passed its biggest preflight test milestone: the critical design review. It passed with flying colors, he reported.

The KC-46 program is now 35 months along, following several abortive attempts at tanker recapitalization since 2001. At the time, then-Air Force Secretary James G. Roche suggested leasing Boeing KC-767s, examples of which have since joined air forces in Italy and Japan. After Congress nixed the idea of a lease or sole-source buy, a competition was held and an Airbus A330 tanker derivative dubbed KC-45 was chosen. That award was thrown out after a heated protest, and Boeing won a second competition with its 767-based tanker, named KC-46 by USAF.

Boeing has to achieve nine key performance parameters and five key system attributes—KPPs and KSAs—to fulfill its KC-46 obligations, and "we're projecting that Boeing will meet or exceed all of those," Thompson said. Development of the new

tanker/airlifter is now 45 percent complete, he noted, with some milestones accomplished early. The critical design review (CDR), for example, closed out in August, "about a month ahead of the contractual requirement."

There were "about 20" issues to resolve at the end of the CDR, he said, six deemed critical. Of those, Thompson described four as "paperwork kind of issues." Two were design refinements. One had to do with "max-power takeoff capabilities" and the other with the aircraft self-diagnostic reporting system. The issues were resolved and CDR was officially concluded. Completion of the CDR and the approval of better than 93 percent of the drawings gave Boeing the green light to begin heavy fabrication efforts. Some four months later, the first aircraft emerged.

This first airplane is not yet a KC-46, however. Its technical designation is 767-2C—a new variant of the venerable 767 airliner/freighter line, featuring the 787's glass cockpit and best-of-elements from other Boeing aircraft. It is provisioned with all the wiring, plumbing, structural elements, cargo doors, and other features that will allow it to be configured later into an all-up aerial tanker/airlifter. To meet FAA and other government rules regarding new variants of commercial aircraft, however, it must first earn civil airworthiness certificates.



Maj. Gen. John Thompson, USAF's program executive officer for the upcoming tanker, is bullish on the progress made so far.

USAF photo by S/A. Steele C. G. Britton



Boeing illustrations

An artist's illustration of a US Navy F/A-18's cockpit view during refueling from a KC-46. A requirement for the tanker is the ability to refuel both boom and drogue-type aircraft on a single sortie, but not simultaneously.



A mock-up of a KC-46 cockpit. The KC-46 borrows many "best of" components from various Boeing aircraft.

All KC-46s will be produced in the 2C configuration from the Boeing production line in Everett that also produces commercial 747s, 767s, and 787s. After that, it's on to a finishing center where all the tanker-specific gear will be installed.

This is a different approach than in previous programs, where the Air Force made use of off-the-shelf commercial aircraft designs, Thompson said in a September speech at the Air Force Association's Air & Space Conference.

In previous programs, USAF would typically buy a stock commercial aircraft body, fly it to a modification location where "we ... disassembled it—tore it apart to turn it into whatever we were trying to build at the end," Thompson said. The new approach saves the teardown step, avoiding unnecessary rework, considerable cost, and stress on the aircraft, Thompson said.

To save time and money, Boeing and the Air Force have designed a "test once" approach with the KC-46: testing multiple attributes for different regulatory entities

simultaneously on each flight of the four test aircraft, instead of waiting to do them in a sequential fashion.

"It's essentially a risk reduction effort," Thompson explained in the interview. "Each flight will maximize the amount of data collected to satisfy the requirements of multiple agencies." These

include the FAA, the developmental and operational test communities, the Air Force Operational Test and Evaluation Center, Air Mobility Command, and others. Performance will be verified "to the maximum extent possible on flights where each one of these major stakeholders have equities in that flight," he said.

"We think that represents a true cost savings to the program, and in fact, we absolutely need to do it if we're going to stay on schedule," Thompson said, adding, "if we tried to meet everybody's requirements in a serial fashion, ... we'd never make it."

Though the 412th Test Wing at Edwards AFB, Calif., will have responsibility for the test program, most test flights will be flown out of Everett. Facilities are being built there to accommodate the various entities involved.

The four Engineering and Manufacturing Development aircraft will be of two configurations initially, explained Charles L. Johnson III, Boeing vice president for Air Force mobility, C3 networks, and support systems.

"EMD aircraft No. 1 and 3, they'll start out in a 2C configuration" and go directly to flight test, he said, while Nos. 2 and 4 will be built as 2Cs, and then immediately be fitted with all the airlift and aerial tanking systems, such as the boom and probe, and military-unique systems and avionics. They will then begin tests as tankers. The 2C needs to get an amended

type certificate, “then the next step is to get a supplemental type certificate, ... that it’s now a KC-46. That’s why two of [each]” are being built, he said.

The two provisioned freighter 767-2Cs will be modified into full-up tankers after about six to eight months and rejoin the test fleet as KC-46s. Later, they will become operational aircraft.

The goal is to build 179 KC-46s by 2027. Low-rate initial production gets going with seven airplanes in Fiscal 2015, followed by 12 in Fiscal 2016. From Fiscal 2017 until program conclusion, the annual rate will be 15 airplanes. Thompson said Boeing can up the rate if there are foreign sales of the aircraft. He said there have already been some international inquiries, but the program is only now setting up an office to manage foreign military sales.

First Flight

The first all-up KC-46 is scheduled to be rolled out less than a year from now, in late 2014. The first conversions will be done at Boeing Field, near Seattle, but the finishing center will move to Everett to save the need to fly the aircraft 30 miles from their initial assembly point. Once that transition takes place, they will simply be towed from one facility to another, Johnson said. First flight of the first fully configured KC-46 is slated for early 2015.

The formal CDR was about a weeklong affair in July, Johnson said, but was the culmination of more than a year’s worth of workup reviews on every subsystem of the aircraft, when more than 100 action items were identified and cleared. The actual CDR was more of a pro forma event recognizing that all major issues had been resolved.

After the CDR, Johnson attended a briefing for Pentagon acquisition, technology, and logistics chief Frank Kendall, who Johnson said was “just kind of astonished” the CDR had been so clean, with “no major issues.”

The purpose of the CDR, Johnson said, was to verify that the design does, in fact, meet requirements.

“And that was 100 percent confirmed, that the design would meet all the KPPs and KSAs and then some,” he asserted.

By contract, the KC-46 has to meet some 392 specific requirements. The KPPs include the ability to refuel both boom and drogue-type aircraft on a single sortie, as well as refueling multiple aircraft at the same time; range and fuel offload; ability to function in the world air traffic control environment; cargo, passenger, and aeromedical evacuation capabilities; the ability to receive fuel from another airplane; ability to function in a chemical/biological weapons environment; ability to function as part of a USAF network; defensive systems, including an armored cockpit and missile warning/countermeasures; and capability for night vision systems.

The “extent of the government liability” on the fixed-price development effort is \$4.9 billion, Thompson said. Boeing’s own “estimate at completion,” however, is about \$5.2 billion, while the Air Force’s estimate is \$5.7 billion, he said. That means Boeing is set to take between a \$300 million and \$900 million loss on development if the numbers don’t improve.

Johnson acknowledged that Boeing’s loss-leader bid was “aggressive,” but he said the company has rigorously managed costs—a quarterly review is conducted by the company’s chief operating officer—and is laboring to find efficiencies wherever it can. Moreover, Boeing has scrutinized costs “down to the smallest parts” and got vendors to offer their best prices for the competition, as well.

“We picked the best of the best” in personnel and vendors, and the corporate mantra “One Boeing” means the program can call on any other part of the company for help if it needs assistance, he maintained. The key is to be “as lean and as efficient as you

can.” Part of that will be to carefully manage manpower, a “big cost” that can be kept efficient by “making sure your manpower is moved to another project” as soon as a particular task is completed.

Johnson declined to say at what point Boeing believes the KC-46 would become profitable. However, he pointed out that costs are being tracked “day to day, week to week,” and the company’s best minds are working to close the gap between the expected cost and the contract price.

The C-17 program was initially a fixed-price development contract, but the program failed in its early years and needed a cash bailout before it got back on track and wound up producing a high-quality product that met cost and schedule. Johnson—once USAF’s C-17 program manager—said he was acutely aware of this and that Boeing had taken the lesson to heart.

Boeing has weathered criticism that it was drawing heavily on program management reserves in the past year and that its burn rate of development funds was unsustainable. Johnson likened the management reserve to a bank account. Rather than have it sit there—until a crisis occurs—“you can make the appropriate withdrawals from the management reserve early on and apply it to reducing your risk,” he said. Boeing has done this by creating a number of System Integration Laboratories, or SILs, to thoroughly wring out subsystems such as fuel management—called wet labs—and make sure they have no integration issues when it’s time to put them in the airplane.

Since the advent of SILs, though, Johnson said Boeing has been “making deposits” in the management reserve and building it back up—a fact he informed Kendall of in the fall.

Asked how risky the financial situation is, Thompson said, “They are executing according to the contract currently. They’ve met all the milestones and contractual obligations to date, and the government expects that performance to continue.”

No Specific Cost Concerns

“The fixed-price nature of the contract provides what we think is a really significant incentive for Boeing to deliver on time,” Thompson said. In the immediate wake of the CDR, he said he doesn’t see “a specific cost risk that I can point to that I am particularly concerned about.”

Software, the critical bugaboo in most major weapon systems, is not viewed as a heavy risk on the KC-46. “About 85 percent of our software is commercial, off-the-shelf software,” he said, “and most of that is in the reuse category,” meaning 85 percent of the KC-46’s software is already flying on other aircraft. Johnson suggested this was one of the areas that made Boeing’s proposal a lower risk. The 15 percent remaining has to do with “military-unique avionics or for our refueling system,” Thompson explained. SILs are expected to produce a largely bug-free systems for them. Software is well in hand, he said, adding that he won’t be “laser-focused” on it to the detriment of the overall system.

There are other risks to the program, Thompson said. Software is one of five, he said, the others being flight-test execution, production schedules, the refueling system, and aircraft weight.

“We like what we see in those areas” so far, Thompson said—Boeing has “done a commendable job on managing the empty weight,” for example—but they all bear constant vigilance. He also told the AFA audience that because the KC-46 will be assembled from parts made around the world, weather that could interfere with shipment of large assemblies and overseas labor turmoil might also be risks to watch.

Thompson told the AFA audience he gets asked frequently if the KC-46 will use the same batteries as the 787, whose lithium-ion batteries caused fires that grabbed headlines early last year. The



Major sections of what will be the first KC-46 are joined at Boeing's plant in Everett, Wash.

KC-46 will use nickel-cadmium batteries, he said—"completely different" from those on the 787.

One of the key undecided variables about the KC-46 program is how the Air Force will support it long term. While USAF requires the ability to organically maintain its aircraft at domestic and overseas bases, the KC-46 could tap a global network of parts suppliers and repair capabilities, as there are more than 1,000 commercial 767s flying and more are still coming off the line. Moreover, many of the parts on the KC-46—from landing gear to hydraulics parts and even tires—are common to Boeing's other aircraft, such as the 747 and 787. The flat-screen panel displays on the 787, for example, are identical to those to be used on the KC-46.

"We're not going to be a 'CLS [contracted logistics support] for life' program," Thompson said. Boeing will provide CLS for the first five years. After that, the nature of support will await the results of a study now ongoing, called the sustainment feasibility demonstration, he explained. It will try to determine "the best method for maximizing the use of commercial practices and procedures for our long-term support." To be decided is whether KC-46 will have a unique, common, or hybrid parts pool. The FAA will play a role in making that choice.

Right Size Tanker

Johnson said the sustainment issue may depend in part "on how we do" in those first five years of supporting the KC-46, but the potential for cost savings by tapping the existing 767 support infrastructure "is huge."

Thompson praised the teamwork and communication between Boeing and the government on the program so far. It has been "exceptional" in the buildup to the CDR and first flight. "Issues that can't be resolved at the lower levels are elevated in a timely manner," he said, and "don't seem to linger. ... If we have a risk and we need a mitigation plan, we get those mitigation plans established and then we monitor them through to resolution."

It's not all "collegial," though, he said.

The cooperation so far "doesn't mean we don't have our fair share of spirited conversations on specific issues," but he characterizes these disputes as "people looking out for the equities of their organization, and sometimes those crucial conversations are required."

During the budget sequester of the last fiscal year, the Air Force and the Department of Defense "took very, very good care" of the KC-46 when its funding was problematic, Thompson said. Money was found and paid at the right times to ensure there were

no breaks in the program that would derail its schedule, and other agencies supplied "extra bodies" when the bulk of his engineers were furloughed during the CDR. By late October, however, he did not know how the program would fare with continued sequester, except to say it would remain a Pentagon priority.

The KC-46's capabilities are "impressively larger" than those of the KC-135's, Thompson told the AFA crowd. The new aircraft "is about 15 to 20 percent larger" and can carry "three times as many" cargo pallets as a KC-135, "two times the passengers and a lot more patients"—even more than the KC-10—all while delivering triple the fuel to thirsty aircraft at a faster rate.

It should be noted the KC-46 "is a widebody" compared to the KC-135, Johnson said. He suggested the aircraft will be "a game changer" because it will be able to do so much more than the KC-135, even though it is only slightly longer and wider. For a foretaste of just how much more capable it will be, he said, it's useful to remember that the outsize C-17 replaced the C-141 while occupying roughly the same amount of runway real estate.

"It's like having two [C-]141 tubes back there," he said of the C-17. Time will show that the Air Force made a good call in picking "the right-size jet" for the tanker, he predicted.

"Why are FedEx and UPS buying 67s and not 47s?" he asked rhetorically. Both have the larger airplane, but decided the 767 was efficiently sized for the times and the workload. The Air Force similarly needs an aircraft not only fuel-efficient but "also for getting the combat mission done."

The success of the KC-46 so far hinges largely on the fact that there have been no changes to the requirements since the contract was drawn. "That stability ... enables us to get the schedule execution we've had thus far," Thompson told the AFA crowd. "We need to continue that. We need to continue to ensure that the program is adequately funded and that we keep requirements absolutely stable."

The fact that there is no improvement program yet contemplated "speaks volumes for the design we have now," Johnson asserted. "It's phenomenal that there's really nothing there that screams, 'Hey, improve me.' The technologies that have been inserted into the 67 are pretty advanced." It's unlikely the design will be altered "until after the Air Mobility Command guys get the jet and actually work with it a while." ■