Photo by Katsuhiko Tokunaga

An F-22 on the flight line at Kadena AB, Japan.

Raptors for the Long Haul

The Air Force and Lockheed Martin have a plan to make the most of the F-22 fleet. As always, money will be an issue.

By the end of next month, the last F-22 Raptor built—tail No. 4195—should complete final checkout tests, take off from Lockheed Martin's plant at Marietta, Ga., and fly to its new home at JB Elmendorf-Richardson, Alaska. Lt. Col. Paul D. Moga, once Air Combat Command's F-22 demonstration pilot, and now commander of the 525th Fighter Squadron at Elmendorf, will fly it there.

As that last delivery flight takes place, the Air Force will confront a long list of challenges with its fully deployed F-22 fleet. Contentious basing issues seem to have been ironed out, but the F-22 modernization and upgrade budget has been halved, compelling the service to be far more selective about Raptor improvements.

The flying hour program is changing, too, because the fleet is not racking up hours at predicted rates—so much so that fleet managers don't think the F-22 will need a service life extension program. Meanwhile, the Raptor's production tooling is being retained against the chance that defense leaders have guessed wrongly in the new national military strategy and that more F-22s may be needed.

The factors underlying the strategic pivot toward the Middle East and the Pacific, called out in the new military strategy, seem to favor further investment in the F-22. Both regions present a range of medium- to high-end threats, including anti-access, area-denial scenarios (A2/AD) and near-peer military allies.

The F-22's stealth, speed, and lethality make it indispensable for both regions. Defense leaders clearly think so: Raptors have repeatedly deployed to the Middle East and Pacific for training and exercises.

With the new strategy comes a new austerity, however. The Air Force's entire modernization program is at risk, and only a few projects have been walled off from reductions.

Air Force Secretary Michael B. Donley assured Congress in 2009 that while the F-22 buy was being truncated at 187 aircraft, the service would invest some $7 billion into F-22 improvements over the ensuing five years. The menu included everything from data links and connectivity with other aircraft to weapons. As the budget has come under duress, however,

By Marc V. Schanz, Senior Editor

Photo by Katsuhiko Tokunaga

Raptors bank off the coast of Japan. The F-22's stealth, speed, and lethality make it indispensable against threats in the areas emphasized in the new national security strategy—the Pacific and the Middle East.

the dollar value of the F-22 improvement program has plummeted. In recent months, senior officials have said it will be just $3.5 billion over the Future Years Defense Program.

In January, an Air Force spokeswoman said the service expects to have the results of a "should-cost" analysis of the F-22 program by October. Then-Air Force acquisition executive David M. Van Buren first announced the review in June 2011, when he confirmed F-22 investment would decline by about $3 billion, due to the deferral of some content, such as the data links.

Some ACC officials, however, think the $3.5 billion number itself is probably unrealistic, especially in light of the planned USAF force reductions and spending guidance from Congress. In Fiscal 2013, $808.4 million is requested by USAF for the F-22 program, down from $916.4 million in Fiscal 2012. The money is slated for key upgrades and improved maintainability and reliability projects.

Maj. Russell Hall, ACC F-22 program element monitor, said the next budget—the Fiscal 2014 plan—is already making its way through the approval process and should include many F-22 upgrade efforts. However, the improvement program has shaken down to a few discrete groupings.

The Increment 3.1 upgrade for the F-22 fleet began fielding and undergoing evaluation last fall and includes ground-mapping synthetic aperture radar modes, electronic attack capabilities, electromagnetic emitter locators, and integration work with the GBU-39 Small Diameter Bomb.

The next phase—Increment 3.2—is now split into two parts, with the first to come in Fiscal 2014 and the second by Fiscal 2017, Hall noted. Increment 3.2 Alpha "is on track. ... It's a good news story," he said, noting the "Alpha" part of the upgrade is primarily software driven.

Beyond Traditional Roles

The second part, 3.2 Bravo, will cost more, Hall noted. It includes a suite of improvements to targeting, jamming resistance, and ground collision avoidance electronics and full compatibility with advanced AIM-120D AMRAAM and AIM-9X air-to-air missiles.

"We're looking at aircraft being modified with 3.2 Bravo in the 2017 timeframe," he said, but that date has slipped. "It used to be 2012, [then] 2013, 2014, [but] it's been funding realities and changing budget targets."

The content of future "3.3" Raptor upgrades is still being hashed out. Among the leading candidates are side-mounted active electronically scanned array (AESA) radar and helmet-mounted cueing systems. Much will depend on out-years funding and the results of the should-cost review, which is ongoing.

More immediately, all tails in the F-22 fleet after Lot 3 will be brought up to the same Block 30/35 configuration—essentially with all the capability resident on the last one off the line. The earlier aircraft, called Block 20, were used for test and are now the designated training aircraft. Although they have combat capability if needed in a pinch, they will not be brought up to the Block 30/35 configuration. However, all F-22s will be tracked by tail number and receive tailored depot maintenance to ensure they live out their full planned lives, and then some.

Asked if the F-22 will need expanded data links, Hall said, "The short answer is yes," since these connections will permit the Raptor to better gather, process, and pass along valuable intelligence, surveillance, and reconnaissance.

As the Pentagon and Air Force emphasize capabilities to deal with anti-access, area-denial threats, the Raptor appears to be headed for a future where it will be asked to perform beyond its traditional role of air dominance.

However, Hall offered the caveat that "the F-22's mission is currently air dominance. It is not an ISR platform. But it has unique attributes in its integrated sensor suite, which allows it to get closer [to an A2/AD fight] than a JSTARS," for example.

Specifically, in high-threat scenarios, Raptors are uniquely able to gather electronic intelligence (Elint), and the Air Force wants to improve ways for the fleet to distribute that information through a network.

"We are looking at different things that we could do to enhance our ability to pass that Elint data to organizations that can process it," Hall added. The bottom line is still funding. Data links for the combat-coded fleet are being explored; they would need to connect fifth generation sensor data to fourth generation platforms. Today, the F-22 cannot transmit much of its vast sensor take.

Air Combat Command, in a statement, said that it remains "committed to maintaining air superiority with fifth generation fighter capabilities." Maneuverability, survivability, advanced avionics systems, multirole capabilities, and stealth offer national leadership the ability to hold "any target at risk anywhere in the globe," ACC added.

Over the next year and a half, the Raptor fleet will consolidate at just four main locations, as Holloman AFB, N.M., loses both its Raptor squadrons and transforms into an F-16 training hub.

By the end of 2013, the last remaining F-22s at Holloman will move to Tyndall AFB, Fla., where two full squadrons will operate—one combat-coded and one for the training schoolhouse, explained Hall. The combat-coded fleet will by then have bedded down with two squadrons each at JB Langley-Eustis, Va., and Elmendorf and one at JB Pearl Harbor-Hickam, Hawaii (the Air National Guard's 199th FS, which will partner with the active duty 19th FS in an active associate arrangement). This setup, service officials say, will save on infrastructure and operational costs.

ACC planners have examined the possibility of a service life extension program (SLEP) for the fleet in the Raptor's out-years, but so far deem it unnecessary. The F-22 was designed for an 8,000-hour service life; options for a SLEP that would get the Raptor to 10,000 or 12,000 hours have been explored, Hall said, but the cost would be high.

"We don't think we are going to need to go there, based off current use and flying," he said.

Because of the limited number of F-22s and anticipation they would have to train frequently and be a central element in most exercises, Raptor managers worried that the type would be worn out before its time. They began to take steps to reduce Raptor hours; these included supplementing pilots' reduced F-22 time with flying hours in a T-38 companion trainer as well as heavier simulator use and other substitutes.

USAF photo by MSgt. Carlos Claudio

L-r: SSgt. Greg Wills, A1C Darby Ryan, and SSgt. Christopher Stacklin inspect a universal ammunition loading system for a Raptor at JB Langley-Eustis, Va.

The 75 Percent Solution

However, due to funding realities and other factors, this approach is somewhat old news now, Hall noted.

"That was certainly valid thinking, ... but the reality is ... we are not achieving those hours that we thought we would," he said. As operations and maintenance budgets have tightened, so have flying hours. While this has driven greater simulator use, it's no longer for the sake of reducing hours on the aircraft.

Moreover, the F-22s were grounded for several months last year as engineers grappled with a purported problem in the fighter's onboard oxygen-generating system. The grounding lasted so long that pilots lost their proficiency in the type. While there was a surge in flying once the Raptor was cleared to fly again, the hours not flown have effectively extended the aircraft's operational life.

The delivery of Raptor 4195 also spells the end of a massive technological and industrial enterprise.

The Advanced Tactical Fighter program was launched in the mid-1980s and saw two industrial teams compete in a flyoff that pitted the Lockheed, General Dynamics, and Boeing YF-22 against the Northrop and McDonnell Douglas YF-23. The Lockheed-led team was selected in 1991.

At program peak, between 2004 and 2005, about 900 Lockheed Martin employees worked the company's Marietta F-22 line, according to Jeff Babione, Lockheed Martin F-22 program manager. A further 5,000 workers performed primary fabrication and assembly at locations across the country, he noted, and thousands more worked for subcontractors.

Early on, the F-22 program was intended to yield 750 fighters; at that, it would have replaced F-15s, F-15Es, and F-117s. However, the size of the buy dwindled until, in 2009, with no peer competitor fighter revealed, the Raptor line was capped at 187 aircraft. Then-Defense Secretary Robert M. Gates derided the F-22 as an "exquisite" capability in an era when the US could only afford a "75 percent solution."

Air Force officials previously acknowledged a need, based on numerous studies, for 381 F-22s, but acceded to Gates' insistence on a more affordable program and a shift in emphasis to the more multirole F-35. In doing so, they also admitted, however, that the absence of 200 Raptors from their plans would be a calculated risk for the nation's military strategy at the time, which called for forces able to conduct two wars simultaneously.

In a June 2009 letter to Sen. Saxby Chambliss (R-Ga.), then-head of Air Combat Command Gen. John D. W. Corley said that while 381 Raptors would deliver a tailorable package of air superiority to combatant commanders, a fleet of 187—in his opinion—would put execution of the current military strategy at "high risk" in the near to medium term.

Since then, the Air Force has retired some 250 tactical fighters from its fleet and has requested the retirement of a

further 120. The emphasis on multirole aircraft is one of the reasons why senior USAF leadership strenuously defends the F-35 in public statements, noting its fifth generation attributes make it the only feasible partner for the F-22 against advanced threats.

DOD's most recent national security strategy also largely abandoned the need to fight and win two nearly simultaneous major theater wars. A less intensive strategy of winning in one location while holding the line in another is expected to be less resource intensive.

Many of the F-22 workers have now migrated to other programs, on the company's F-16 line, its C-5 upgrade work, and F-35 assembly in Fort Worth, Tex., Babione noted. The F-35, despite its protracted development, enjoys vigorous congressional support, and Pentagon leaders recognize the fighter is the sole fifth generation option for the continued modernization of American military fighters.

The Raptor has left a strong legacy of lessons learned, Babione said. Because the F-22 was the first fifth gen fighter, "we pioneered some skills that were never done before, and that has been good for the assemblers to go work [on the] F-35."

The F-22 proved a pathfinder in stealth coatings and technology over the years, he noted, and on how to design and build a fifth gen aircraft.

"It's a great skill in high demand," he said. While Lockheed Martin needs the knowledge gained on the F-22 to make the F-35 a success, the Air Force needs the workers' skills to help maintain the F-22 fleet's low observable coatings. This work will likely continue for years to come.

The F-22 program office at ACC emphasizes that the Raptor's maturation is not dependent on the F-35's progress.

"The F-22 ... is completely independent of the F-35 program," Hall said, noting that the incremental upgrades and modernization path slated to run into the 2020s have been in place for years, dating to when the Raptor roadmap was devised. He also observed there won't be another fifth generation aircraft in the fleet for quite a while.

"The F-22 is going to fill a gap in this decade," Hall said. It is "ready ... and ... capable of it." The F-22 will bear a heavy burden in achieving air dominance and takedowns of strategic air defenses, which the current configuration can accomplish. Air Force officials appear to agree, pointing out that the two fighters are complementary, but while each is optimized for their respective air-to-air or air-to-ground missions, both have "multirole capability," an ACC spokesperson said.

In addition to capability enhancements, Lockheed Martin emphasizes maintainability.

"We have continued to focus, from first to last, on increasing the reliability of the aircraft," Babione said of the difference between earlier Raptors and the later models. The ease of sustainability and maintainability of the F-22 steadily improved to the end of the line, and he noted the program office and USAF continued to upgrade maintenance practices on subsystems, generators, avionics, hydraulics, and other components.

"The [standard] requirement is that the mean time between maintenance is three hours or greater," Babione said, adding the last aircraft from the line have regularly exceeded this benchmark—and some are well above it.

There are some persistent maintenance issues, but USAF and Lockheed Martin officials believe they are well-understood and progress is being made. ACC officials noted the F-22 is no longer experiencing large sections of low observable (LO) coatings stripping from the canopy in-flight. The current LO system mean time between replacement is some 250 flight hours, according to ACC, but a new system is due in the fleet this year and will raise this number to around 400 hours.

Resiliency of the LO-coated canopy is another issue; the requirement states a mean time between replacement of about 800 flight hours, but ACC states technology to support external transparency on high-performance aircraft is "not available at this time." There are enough canopy spares available for peacetime and contingency operations, an ACC spokesperson said.

Still Relevant

While the line has ended, the Air Force has pointedly invested in preserving the infrastructure and tooling, which has steadily been disassembled over the last year and a half, Babione noted.

Lockheed Martin has identified some 30,000 tools USAF and the company would like to preserve, not only at Marietta but also among suppliers. Tools from the Marietta facility are being stowed away—shipped to the Sierra Army Depot in California—in a process concluding around June, Babione said. Components are being cataloged and tagged with RFID (radio frequency ID) indicators, he said, and hours of video interviews have been conducted with mechanics and workers to record valuable information on how to fabricate some of the Raptor's parts.

"All you have to say is, 'I want to build a wing skin' [and] the tools you need ... are in [a certain container]," he explained. Even components that have never been fixed are being itemized and cataloged.

The effort and expense is indicative of how much USAF wants to preserve the option to ramp up the capability in the future, for unforeseen circumstances—called "reversibility" by senior USAF and Pentagon officials.

The Raptor's future is still being updated and tweaked, as planners in the Pentagon scrub budgets for savings. However, the fighter's relevance seems mainly undiminished, given that USAF seeks to trade force size for quality.

While the F-22 has been a star in exercises where it has racked up a hugely lopsided number of air-to-air victories, a cloud hangs over its horizon in the form of an unresolved technological glitch. The fleetwide grounding was due to an apparent problem in the onboard oxygen-generating system (OBOGS). A number of F-22 pilots reported problems that suggested some degree of oxygen deprivation.

The bleed air system which drives the OBOGS was also a contributing factor to the November 2010 crash of an F-22 in Alaska that claimed the life of the pilot.

A series of investigations into both the crash and the larger oxygen-supply issue has not provided much clarity. The F-22 fleet was ultimately cleared to resume flight with additional safety precautions even though there was no definitive resolution of the problem.

The final Air Force accident investigation report on the Alaska crash laid blame on the pilot for not reacting quickly to air supply problems, but acknowledged equipment failures as well. The Pentagon inspector general, in a rare action, decided in February to review the accident board report and conclusions.

That wasn't the only study of the problem still ongoing at press time. In late February, USAF officials said the Air Force Scientific Advisory Board task force did not find a "smoking gun," but the service will implement a series of fixes. Foremost among them, a backup oxygen system will be reinstalled (the initial system was axed years ago in a weight-cutting drill during development), software fixes will be applied, and new oxygen sensors installed. The final report from the SAB task force was expected in March. ■