



**USAF can't do without workhorse C-5s,
and it can't afford to replace them, so it has to make
them work better.**

Saving the Galaxy

By John A. Tirpak, Executive Editor



THE story of the Air Force's C-5 Galaxy airlifter is a tale equally divided between promise and problems. In the recent surge for Gulf War II, for example, the huge transport aircraft proved invaluable, giving the logistics train a kick in the pants so that supplies could move swiftly to the war theater.

Gen. John W. Handy, the commander of US Transportation Command and Air Mobility Command, recalled, "In this last conflict," there were "many, many times when, frankly, the only way to unclog" Charleston AFB, S.C., Dover AFB, Del., or Ramstein AB, Germany, was "to get the C-5 in there in sufficient numbers ... and, literally, in a weekend, ... clean out all three aerial ports."

The C-5's vast volume—the ability to carry 36 standard pallets, and 265,000 pounds of cargo, roughly double that of the newer C-17—is an "astounding capability," Handy said.

He added, "We certainly need to keep [it] at our fingertips for as far as I can see into the future."

The Galaxy also has major problems, as was glaringly apparent during one particular C-5's trip from Dover to Europe. As it readied for takeoff, an engine warning light appeared in the cockpit. The flight crew taxied the airplane back to the apron, the passengers got off, and maintenance crews investigated. After the problem was fixed and the passengers had reboarded, the aircraft headed out again, but another warning light came on—this time during the takeoff run.

Five more times, the C-5 attempted to leave, and each time there was a glitch.

Airborne at last, the heavily laden giant lumbered up to cruising altitude, but, some 100 miles out over the Atlantic, yet another warning light came on—this time, a landing gear door seemed ajar. The airplane returned to Dover for yet another re-



Dwarfing a KC-135, a C-5A takes on gas. The Galaxy was the largest aircraft in the world when it entered service. More than 30 years old, some C-5As are being retired, but others may be around for another 20 years.

pair. The C-5 finally reached its destination in Europe—but more than 18 hours late.

Most C-5 missions are not nearly as fraught with mechanical problems as this one, but such episodes are not rare, either. The C-5 has been a poor performer in the reliability arena since its entry into the fleet in 1970. During the wars in Afghanistan and Iraq, the transport edged close to Air Mobility Command's standard mission capable rate of 75 percent, but its typical, nonsurge performance puts it in the 65 percent range.

If the huge airlifter could be made to work reliably and predictably, AMC officials say, it would vastly improve scheduling and give a big boost to overall airlift capacity.

To make that happen, AMC is planning a two-step upgrade that is expected to bring the C-5 fleet up to—and possibly well beyond—the command's 75 percent mission capable benchmark.

No Replacement

There are few alternatives to making the C-5s work better, according to Handy. The idea of replacing the C-5 outright, he said, is a nonstarter.

"In all sincerity, there is an awful lot on the plate for the budget, and that's just from an AMC perspective," Handy observed. "If you look at it from an Air Force perspective, it's an even greater challenge."

AMC is one of the few commands that is consistently receiving new airplanes. The C-17, AMC's top priority, is being delivered at the rate of about one a month, and the command is also receiving new C-130Js—both are being bought on a multiyear contract basis. In addition, Congress recently green-lit USAF's plan to lease and buy 100 KC-767 tankers to replace 40-plus-year-old KC-135Es.

Taken collectively, this recapitalization of the airlift fleet "consumes a tremendous amount" of the Air Force's discretionary spending, Handy said. Given that the C-5 fleet can be improved for about \$75 million apiece—vs. about \$204 million to purchase a brand-new C-17—and that much of the Galaxy fleet still has about 80 percent of its design life ahead of it, the C-5 is a capability that AMC isn't about to discard.

Nor can it. The C-5 is the only aircraft able to lift some of the oversize and outsize gear that the US military needs moved from time to time—things like special operations assault boats and scissors bridges.

However, the outsize/oversize issue is not of prime concern to Handy. He actually sees the need for such missions declining.

All the services, Handy observed, are trying to get "light, lean, and lethal." The Army, he noted, is trying to move toward gear that will

require nothing larger than a C-130 to move.

"That tells me that, as a transporter, my job for really large stuff by air is going to be diminished over time," Handy said. "Some time in the next 10-15 years, that could go away entirely as a requirement."

However, the C-5, he said, "is an airplane whose value is dramatically underappreciated, I think, outside Air Mobility Command and TRANSCOM." Sometimes, Handy said, "it's not just the outsize and oversize that drives that requirement."

Unsung Warrior

While the C-17 stole the spotlight in Afghanistan and Iraq by bringing troops and equipment directly to the front lines, the C-5 fleet brought nearly half (48 percent) of all cargo to the two countries during both Operations Enduring Freedom and Iraqi Freedom.

A total of 131 C-5s have been built. The first 81 were C-5A models built in the late 1960s and early 1970s. In the 1980s, production resumed, and 50 new Galaxys—designated C-5Bs—were built with some modest improvements. Two of the original C-5As—designated C-5Cs—were specially modified to carry spacecraft pieces that need to be transported quickly. Today, there are 126 C-5s left: 74 A models, 50 Bs, and two Cs.

AMC's two upgrade projects now in development are expected to give the C-5 sharply better performance. If they work, they will allow the big aircraft to complete far more missions each year, adding significantly to strategic airlift capacity. The two projects are the Avionics Modernization Program (AMP) and the Reliability Enhancement and Re-engining Program (RERP).

Neither program is intended to extend the C-5's service life, which AMC analysts think already could last beyond the 2030s. Rather, the upgrades are intended to make the Galaxy fleet more reliable, more efficient, and able to comply with increasingly stringent rules regarding international airspace management.

The AMP is replacing the C-5's old analog instrumentation with digital "glass cockpit" displays and communications equipment that will bring



This HH-60G Pave Hawk looks tiny in the cavernous cargo bay of the C-5; up to six of these helicopters will fit inside. The C-5 is unrivaled for its outsize/oversize cargo-carrying capacity.

it into compliance with Global Air Traffic Management rules now in effect overseas. These rules demand more precise navigation and smaller separations between aircraft, as well as new communications gear, among other performance requirements. (The rules are designed to speed up commercial air traffic by increasing the number of aircraft that can be allowed in a given region of airspace at one time.)

The new equipment will also reduce the amount of service needed for C-5 avionics, replace problem-prone systems with less costly commercial units, and increase the intervals between hardware failures.

Without the GATM upgrades, aircraft must fly longer, more circuitous routes at less-desirable altitudes. That, in turn, leads to greater fuel consumption, smaller loads, and reduced efficiency all around. The AMP will help "buy back" access to preferred routes and altitudes that would be denied to the C-5s.

Two test aircraft already have been fitted with the AMP upgrade, and 47 more C-5Bs are funded, according to Maj. Gen. Mark A. Volcheff, AMC's director of operations. In all, AMC expects to perform the avionics update on 112 airplanes: 60 of the older C-5As, all 50 C-5Bs, and both C-5Cs. Upgrading all 112 will take until 2010. The remaining 14 C-5s will be decommissioned.

"We plan to start retirement of 14

C-5As this fiscal year," Volcheff said.

The aircraft in question happen to include the oldest 11 C-5As, plus three others that have posed particularly vexing maintenance problems over the years.

AMC found those "worst actors" by conducting a logistics study, said Maj. Christopher Leist, an AMC planner.

There is no one problem that accounts for all the airplanes' troubles, Leist said, noting "various issues, including hydraulic leak problems [and] reliability problems with the

engines. We have obsolescence of parts issues such as [with] fuel indicators—those sorts of things."

The retirements mirror the Air Force's decision last fall to retire some KC-135Es. Even though the aerial refueling capability was still needed, the aircraft themselves were no longer cost-effective to keep flying.

Examining the Stress

One of the retired C-5As will be X-rayed and torn down, panel by panel, spar by spar, to see just how stressed, cracked, and corroded it is. The information obtained in the tear down will be used to determine whether to give the RERP upgrade to all the C-5s or just some of them, Volcheff explained.

The big upgrade will have to wait until the aircraft receive the AMP, however.

"AMP is the prerequisite for RERP," Volcheff said.

The new avionics are not only necessary to comply with the international air traffic regulations, they are also needed to enable installation of the far-more-involved RERP. Under this second upgrade, the C-5s will receive four new engines—with digital engine controls—and pylons, as well as a new engine-driven generator and auxiliary power unit. Additional improvements will be made to the landing gear, hydraulics, flight controls, and environmental control system. All in all, there are more



Lockheed Martin photo by John Rossino

The Avionics Modernization Program brings the C-5 into the 21st century, with glass cockpit avionics, digital systems, and the ability to comply with new international air traffic regulations.



Three C-5s—two B models and one A—will get the RERP upgrade. They will then be evaluated and test-flown for two years. If approved, the upgrade would take until 2018 to refit the entire fleet.

than 50 systems on the airplane that will be replaced or revamped.

Both upgrades are being performed by Lockheed Martin, which built the C-5 in the first place. The company has selected the General Electric CF6-80C2L1F turbofan power plant to replace the old, problem-prone TF-39 engines.

The new engine is “very common ... in the [airline] industry,” Volcheff noted. The CF6-80 series has “a well-established track record” commercially on 767s and is used on Air Force One, the KC-10, and the E-4B, he said. The engines would be factory-new, not reconditioned.

The new engines are essential to meet the rest of the GATM rules, which require aircraft to expedite a climb to an assigned altitude. Carrying a full load, the C-5s today simply cannot get to that altitude fast enough. With the RERP improvements, a fully loaded C-5 could take off and get to an assigned 31,000-foot flight level in only 20 minutes—13 minutes faster than it takes the unmodified aircraft to get to 26,000 feet today. Once modified, the C-5 will also be able to use shorter runways.

In reliability terms, the engine improvements alone are expected to raise the C-5’s mission capable rate from about 66 percent to more than 72 percent, or more than half the way toward the required level.

Once an aircraft has received the RERP upgrade, its designation will change to C-5M.

However, Air Mobility Command has not yet committed to the conversion program. It plans to test out the modifications on two C-5Bs and one C-5A to determine if the improvements truly will provide the anticipated boost in performance and reliability.

“We’re going to RERP an A and ... two Bs, ... and then we’ll do testing and evaluation of their viability,” Volcheff said. “If they’re both successful, then we continue on.”

Lockheed Martin has offered a warranty that the RERP airplanes will achieve a 75 percent mission

capable rate but believes the actual figure will be closer to 85 percent.

The average number of flying hours in the C-5A fleet is about 18,000 out of an expected service life of 80,000. The B models, which were used more in recent operations because they tend to be more reliable and, unlike the A models, have defensive systems against missile attacks, average about 14,000 hours. However, Volcheff said he does not expect that the C-5Bs will ever catch up to the A models in service life consumed, despite their greater usage. The A models have a 15-year head start.

The Air Force will begin the RERP modifications for the three test aircraft in September. It will take a year to finish the first airplane, which will enter flight test in October 2005. Flight testing will take nearly two years. Production could begin in 2008.

The modifications would be done at the same time an aircraft comes in for depot maintenance, so there would be no operational impact on the fleet, AMC officials reported. However, the installations would be done at the rate of one a month, meaning that it would take until 2018 to RERP the entire C-5 fleet. That date is a troubling one for Handy.

The C-5B fleet will be done first, Handy said, because the airplanes are newer, more capable, and represent the biggest bang for the buck. By the time the B models are fin-



USAF photo by TSGt. James Mosman

Although unable to use dirt strips right at the edge of the battlefield, C-5s went “most places” in the theater, AMC officials said. The C-5 is a whiz at unclogging backed-up ports.

ished in 2012, though, the A models will be 42 years old and will have seen significant wear and tear.

"By 2012," Handy said, "it may be that the whole notion [of performing the RERP on the C-5As] is overcome by events." The A models, he said, might be too far gone to be worth the investment.

The test determining whether RERP would be worthwhile for the A models will conclude in 2008, but it will be another three years before AMC actually has to commit to the upgrade, an AMC official reported.

"There's ... a chunk of time where you can think about your A model decision," he noted. "We don't have to make it overnight."

Whether the A models go forward into RERP will depend in large part on the results of the tear-down analysis, better models of C-5 utilization, and actual field experience.

Or More C-17s?

It's by no means a cut-and-dried decision. The Congressional Research Service, in an October report, predicted there will be extensive debate on whether to modify C-5s for better performance or simply put the dollars into new C-17s, which seem to be more useful for the kinds of warfare in which the US is now engaged.

Supporters of the C-5 upgrades, the CRS said, will point to the experience in Iraq and Afghanistan as proof positive that "the United States needs all the airlift volume that it can muster" and that the C-5 modifications offer the fastest and cheapest way to preserve capacity. It takes "almost two new C-17s to replace the lost payload volume of every C-5 that is retired," the CRS pointed out.

Those preferring to shift to C-17s, the CRS said, can, in turn, argue that, while overall volume is important, "being able to move large payloads directly to short or austere airfields in the combat theater is more important" and that the C-17 was the only strategic airlifter "that could use the full range of airfields available in the Iraq theater of operations." Like Handy, the CRS noted that the outsize equipment that the C-17 can't carry is becoming "less important" and could travel to theater by ship.

Today, there is less worry that, if



USAF photo by AF C Franklin J. Perkins

A tear-down evaluation of an early C-5A will help AMC officials decide how much life is really left in the giants. All signs indicate the C-5 may be flown by another generation or two.

the C-17 fleet were suddenly grounded, the US would be left without any strategic airlift capacity if it forgoes upgrades to ensure a healthy C-5 fleet.

"We're a little less concerned today than we were yesterday about one-aircraft reliance," Handy said. Because the C-17 has been improved on the production line in blocks over the last 12 years, "you've got enough differences that the likelihood of a fleet grounding [is] even more remote, on top of the fact that ... it's proved itself to be well beyond our fondest expectations for performance."

The C-17's mission capability rate is consistently above 85 percent, and its departure reliability rate averages more than 93 percent. The C-5's departure reliability rate recently averaged just under 80 percent. However, Lockheed Martin projects that the C-5M would have a departure reliability rate of nearly 95 percent.

Moreover, with C-5s, C-17s, KC-10s, KC-135s, and nearly 70 C-141s still in the strategic airlift mix "well into the future," Handy said, "we're not going to face a single-airplane fleet for a long, long time."

Handy is on record as believing that airlift requirements demand at least 222 C-17s, and he has been advocating that the Joint Staff perform a new Mobility Requirements Study as soon as possible to verify or debunk that notion.

"My pressure was to try to get it

done before the budget debates on the 2006 budget ... [because] that's when we have to lay in the long lead [funding]" to go beyond the 180 C-17s now programmed, he observed.

AMC is not treating the C-5M and the C-17 as an either-or issue, command officials said. And there is no reason at this point to think that the C-5M will not achieve its objectives, since the pieces of it are well-understood and software—the biggest unknown—is being built at a rate slightly ahead of schedule.

If the tests show that the C-5M falls short of the 75 percent mission capable goal, "we certainly wouldn't automatically cancel the program," Volcheff said.

"We'd want to find out what is at issue that prevents us" from reaching the goal, he said, and work with Lockheed Martin on ways to reach it.

"Certainly we would have to discuss and negotiate on what they could do to get it there," he added.

Volcheff doubts the C-5 would be discarded in favor of some new capability if the RERP does not pan out in test and can't be made to work.

"We don't have anything on the drawing board that would fill the gap" if the C-5 couldn't go on with the RERP, he said. If the upgrade wouldn't provide the needed improvement, then "of course we wouldn't do it, but the airplane would just go on—at a lower mission capability-mission reliability rate." ■