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A Joint Strike Fighter is being towed into an F-35 hangar at Eglin AFB, Florida.

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Hangars Of Future Will Have Much Different Needs

The design, building and cost of F-35 hangars offer clues to future commercial MRO infrastructure.

Eric Tegler | Mar 06, 2019

Printed headline: Hangar of the Future?

Traditional aircraft maintenance hangars are pretty straightforward: large, enclosed spaces in which aircraft work can be performed out of the elements with a well-known set of tools. But a Lockheed Martin F-35-compatible hangar is not that simple. Its design, building and cost offer clues to future commercial MRO infrastructure.

The F-35 is operating from 16 bases and counting. Thus far, seven U.S. Navy/Marine Corps F-35 hangars and associated facilities have been built at an average cost of $60 million each. As the F-35 fleet expands, the Navy/Marine Corps plans a total of 31 hangar facilities at a cost of $2 billion.

The U.S. Air Force has built 20 F-35 hangars and plans three more. The service has not said how many hangar facilities it will ultimately build or the average cost per facility, but it reports that hangar projects at five bases yield an average of $281.8 million per base. The costs are considerably higher than outlays for a typical legacy fighter aircraft hangar.

Rather than the 400-Hz AC electrical ground power used by generations of aircraft, the F-35 uses 270-volt DC power. Its systems, including its electrically powered flight controls, require more power than previous fighters.

“The F-35 is a very smart aircraft,” says Bryan Bullerdick, CEO of North Carolina-based design and equipment supplier B GSE Group, which has worked on most of the extant F-35 hangars. He explains that if the power provided to the F-35 is not the perfect voltage, amperage or harmonics, the aircraft will not turn on when the ground crew needs to perform functional checks. Centralized electric power systems with long, sensitive supply cables do not work. Not only is such cabling a vulnerable obstacle, the DC current it provides degrades over distances.

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Accordingly, in each F-35 hangar work is done above service pits—under-floor spaces from which electric power, cooling and other services are provided at the aircraft, obviating the need to run cables from remote inverters/converters.

Cooling is another issue. The F-35’s multiple electronic systems generate significant heat. During maintenance, the fighter requires preconditioned air (PCA) cooling at just the right temperature. The air must be very dry at a higher pressure than standard commercial PCA. Sending cool air from specialized high-pressure air conditioners through an underground trunk line which is ducted off to individual service pits is one way to ensure proper cooling.

“We went through a bunch of iterations of how [PCA] might work because there have been a variety of installations,” says Jacob Thurlow, director of project development at Haskell Construction, which is building a new F-35 hangar at MCAS Beaufort, South Carolina. “What we’ve landed on is individual service. We have nine pits and nine aircraft cooling units.”

Haskell’s hangar construction also must accommodate the data-centric nature of the F-35. From the Autonomic Logistics Information System (ALIS) used to maintain the F-35 to the Mission Data Files (continually refreshed geography, airspace and threat data) it uses to fight, the aircraft is a connected repository of classified information. Much of the information is managed and shared from inside F-35 hangars, which must incorporate secure areas called Special Access Program Facilities (SAPF).

SAPF spaces include mission-briefing and flight-simulator rooms, equipment for ALIS data and mission data management and secure network communications. The hangars that house them become data nodes, ripe for legitimate (and illegitimate) data exploitation. Future commercial MRO spaces will face corollary infrastructure and security demands as electrification reaches the airline industry.

Glenn Llewellyn, general manager of electrification at Airbus, says the team working on Airbus' E-Fan X hybrid-electric airliner demonstrator is already thinking through these demands. "Future generations of aircraft will have significantly higher voltage levels than we see today in commercial applications. Those higher levels also raise the challenge of operator and MRO safety and thermal stability," he says.

Airbus is targeting electric power of 800-3,000 volts DC for its E-Fan X and still higher demand for future hybrid-electric aircraft. Their anticipated power and cooling needs raise F-35-like questions for commercial hangar design.

The scope of MRO infrastructure adaptation even goes "off airport," Llewellyn says, encompassing the electricity generation, distribution and prioritization needed to sustain a hybrid-electric aircraft fleet. Electrification also will bring increased interaction between MRO facilities and digital aviation data platforms like Airbus' own Skywise. The hangars will have to be as secure as the software.

Airbus is noting the ripple effects of the changes the F-35 is driving in military MRO. "We're having these discussions even in the research phase of a new kind of aircraft," Llewellyn says, "never mind once a program eventually gets launched."

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