

# Green Knights

## & the Lightning II

**Ted Carlson/Fotodynamics** examines the F-35B in service with VMFA-121 'Green Knights', the USMC's first fleet Lightning II unit.

**B**ASED AT MCAS Yuma, Arizona, VMFA-121 'Green Knights' has been the pioneering F-35B fleet squadron. The US Marine Corps achieved initial operational capability (IOC) in July 2015 and the next milestone to accomplish is full-operational capability (FOC) which is fast approaching.

### The B-model

The teething process has been long, but significant strides have been made in making the aircraft more reliable. Although the F-35 has been on the receiving end of less-than-stellar press reports, it has robust state-of-the-art capabilities with numerous bells and whistles that are typically omitted from those articles.

All USMC F-35Bs are to low rate initial production (LRIP) standard. The Green Knights have received most of the new USMC



F-35Bs and distribute their older to wherever the Corps' needs are. As the first deploying F-35B squadron, the Green Knights have the newest and most up-to-date jets in the inventory.

The unit had 16 aircraft at one time, but after some were distributed to other units and some returned to Lockheed Martin for modification, it will stabilise at ten aircraft for the time being. Long term, it will build back up to 16 F-35Bs, which is the planned allocation for the initial F-35B squadrons. At the moment the situation is fluid as airframe requirements vary.

Software development has been a major focus, with each revised version more intuitive and superior to the previous standard. Block 2B was a significant step because the version in place when the F-35B

was IOC qualified lacked certain software. Block 3i is the latest version, with development of Block 3F under way. A spiral development programme, Lightning II will receive ongoing upgrades throughout most of its service career.

The aircraft is powered by a 41,000lb (182kN) thrust Pratt & Whitney F135-PW-600 afterburning turbofan, propelling it at speeds up to Mach 1.6. The -600 engine is

B-model specific, being equipped with the shaft-driven lift fan and thrust vectoring exhaust nozzle that enable the jet to hover.

The engine has been very reliable and exhibits excellent throttle response. The F-35B has a combat radius of 450nm, farther than the AV-8B. The aircraft is equipped with





**Below:** Marine Corps air assets are set to be revolutionised as F-35Bs slowly replace the F/A-18 Hornets currently in service. The USMC's VMFA-121 'Green Knights' squadron is taking the lead role in this new transition.

guided munitions. As time progresses, additional capabilities will be added to the EOTS.

The cockpit features a 32in touchscreen panoramic display, giving the pilot exceptional situational awareness. The plethora of F-35B sensors relays and prioritises data, delivering it in a logical, precise and intuitive manner that greatly reduces task saturation. There is a side-stick controller on the right side of the cockpit and a HOTAS throttle on the left. The helmet display enables pilots to see what they are targeting. They can also display the Distributed Aperture System (DAS) view and night vision into the helmet. Unlike NVGs, it uses the IR spectrum for night work, improving performance.

The F-35B can carry a pair of AIM-120Cs and two 500- or 1,000lb-class laser and/or GPS-guided weapons internally (at the time of

the very capable AN/APG-81 AESA radar. It will

be able to share information with other TACAIR assets using Link 16 and the Multi-function Advanced Data Link (MADL).

The AAQ-40 Electro-Optical Targeting System (EOTS) is an internally mounted sensor suite that sits just behind the radome, with an external sensor located in a small low-observable glass cage. The system combines forward-looking infrared (FLIR) and infrared search and track (IRST) functionality.

It has an air-to-surface/air-to-air FLIR tracker and air-to-air IRST modes, and contains a spot tracker. This negates the need for targeting pods, enabling the F-35 to operate stealthily and autonomously with precision-

writing, VMFA-121 is using the GBU-12 and GBU-32). The C-model has a longer weapons bay and can therefore carry 2,000lb-class weapons internally.

Wing pylons are under test and being validated for fleet use. They will enable the F-35B to carry 2,000lb weapons externally, along with internal stores. Travel pods and 426 US gal fuel tanks will also be available for external carriage after the aircraft has been upgraded to Block 4 configuration.

The 25mm GAU-22A external gun pod is in development and will be mounted on the centreline station once the software can ►



**Above:** Former Harrier pilot, Lt Col Tyler 'Hefty' Bardo, is the Commanding Officer of VMFA-121.  
**Right:** Lightning II pilots have excellent visibility and utilise an intuitive, large touchscreen cockpit display.

support it. The F-35A has an internal gun, but the C-model will use the same pod as the B.

A major capability, by design, is stealth. This gives the F-35B a huge advantage – if the enemy can't see it on radar during a fight, he becomes somewhat easy prey.

### Knight One

Commanding Officer of VMFA-121, Lt Col Tyler 'Hefty' Bardo has more than 2,000 flight hours. He previously flew the AV-8B and did two tours with VMA-214 'Black Sheep'. He participated in Operations Southern Watch, Iraqi Freedom and Enduring Freedom, and completed a tour with the 31st Marine Expeditionary Unit (MEU) in Japan.

A Naval War College graduate, Bardo was selected as one of the initial VMFAT-501 'Warlords' cadre, flying from Eglin AFB, Florida, for his first F-35 tour. Later he became Operations Officer on a second tour with the squadron. Lt Col Bardo explained to *AFM* where VMFA-121 is at present:

"Now that we're post-IOC, we've been focusing on maintaining our combat capability and are prepared to answer the call to deploy for combat, if tasked," he commented. "This encompasses MAGTF [Marine Air Ground Task Force] integration to 'operationalise' the aircraft. Part of that is participating in all the exercises the other TACAIR assets do. Exercises we've participated in include various CAS frags, EWTGPAC [Expeditionary Warfare Training Group, Pacific], WTI [Weapons and Tactics Instructors] (see *Waging Peace*, July, p48) and Agile Lightning, held at Twentynine Palms, in support of Exercise Steel Knight.

"Agile Lightning took place in December 2015 and we demonstrated the STOVL concepts and capabilities of the jet, moving around different bases. We also operated from the expeditionary FARP at Red Beach, Camp Pendleton during that exercise.

"We have supported the past three WTI exercises and had three pilots graduate from the last course. They were spread between VMFAT-501, VMFA-121 and VMFA-211, bringing the latest tactical expertise to each unit. We helped stand up VMFA-211 and that was a major milestone for our community.

"There are a lot of maintenance man hours



**"We've been focusing on maintaining our combat capability and are prepared to answer the call to deploy for combat."**

and tremendous effort behind the scenes that goes into making us prepared for exercises, because we all know what is at stake with this impressive new aircraft. Our hard-charging Marines keep the jets flying, the mission systems are at their highest state of readiness, and we keep on top of the challenge. That involves operating an all-new state-of-the-art maintenance system.

"Our maintenance numbers have been really good, comparing them to our legacy brethren in other communities. Our pilots are getting the necessary flight hours to train and be proficient due to aircraft reliability, and we are learning about our own parts requirements and making sure the part supply matches the need. We occasionally come across a unique issue or a particular part need, and Lockheed Martin, Pratt & Whitney and Rolls-Royce are very good about being responsive and tackling the issue. During the exercises, our readiness and full mission capable [FMC] rates were higher than our previous six-month averages.

"As we get new software block updates, systems tend to become more stable and reliable, and tighter and tighter with every update. The 3i is the latest software block. The Green Knights initially flew with Block 1B and as the software becomes more capable we're continuing to 'operationalise' the F-35.

"We train with other services and foreign nations during exercises as needed. Being the first operational squadron, we also work with the other US services, the DoD, and even foreign partners that will be operating F-35s. Sharing information



**Above:** A division of Lightning IIs prepare to taxi for take-off on a night mission; the opposition will be USMC F/A-18C Hornets. **Below:** A 'Green Knights' pilot heads to his jet under the watchful eye of his plane captain. Note the open weapons bay.



**Above:** An F-35B prepares to shut down after a night mission. The lift fan door is routinely raised and lowered during startup and shutdown procedures. **Left:** Aircraft '01' undergoes some minor maintenance work in the hangar. During any transition, learning engineering procedures on a new type of aircraft is critical.



***"Whether you were a Harrier or Hornet pilot, it doesn't matter now – we are F-35 pilots."***

will help them through the process of standing up their own F-35 squadrons.

"We fly daily, with multiple sorties every day and often in section or division operations. Basically we fly a lot. In the year and a half that I've been flying the Lightning II, there have only been three or four times that I have had to ground-abort due to a failure of some kind. Regardless, we always have spare jets ready to go. The aircraft has an excellent self-diagnostic system and there is a good chance of fixing it during start-up, or going right to the failing component. It self-checks pre-flight and post-flight.

"We currently carry 500- and 1,000lb-class GPS and laser-guided weapons, plus AIM-120 radar-guided missiles, and we've been using live weapons since June 2015. Arguably, our jet is equipped with

the best radar in aviation right now. It is powerful, reliable and a great system.

"The jet is very easy to fly, it's easy to operate the systems and it's user-friendly. It allows you to take your focus off stick and rudder skills, and concentrate on employment for the mission tasking. In fact, the jet is very stable; during a mission, you are able take your hands off the side stick because the flight controls and software are very forgiving.

### **Fighting Vipers**

"That allows us to work using the large displays and capable sensor suite. It presents you with the pertinent tactical information in a very concise and logical fashion. That makes it much easier to employ against targets compared, say, to the Harrier or Hornet.

"We're currently operating with some constrained flight envelopes, waiting on the final testing to be completed. The current envelope is very good to train in and there is just a small mission set that we haven't explored until the envelope expansion is complete. Then that will allow us to max perform the aircraft up to the designed limitations. It is a much higher performance aircraft than the Harrier – it has a very powerful engine and the software allows us to aggressively manoeuvre without much fear of departing flight.

"The test pilots have done extremely well in missions where they went up against Vipers, Hornets and Super Hornets in the beyond visual range arena, especially in situations where they were able to capitalise on the strengths of the F-35. The aircraft is low



**Above:** The upcoming target for VMFA-121 is full-operational capability (FOC) with the F-35B, effectively meaning the squadron can be deployed on combat operations. Having achieved initial operating capability in July 2015, the flight envelopes, weapons and deployment abilities continue to be expanded by the USMC to reach FOC status. **Right:** A VMFA-121 jets taxis out for a mission. Highlighted by the evening sunshine are the stealth sealant joints, which are similar to those used on USAF F/A-22 Raptors.



**Left:** A section of 'Green Knights' Lightning IIs bank over the Californian desert during a training sortie. **Right:** MCAS Yuma, Arizona is the current home to operational USMC Lightning IIs, now VMFA-121 has F-35Bs in service.



observable, so we have a significant upper hand in BFM engagements because, quite simply, our adversaries cannot see us; the F-35B is extremely lethal and very survivable.

"The Harrier is an extremely intensive aircraft to hover. When hovering in the F-35B, the airplane does a lot of the work itself using its computers, and it is almost hands-off flying. It is completely stable; it holds a tight altitude and deals with crosswinds [it has wind and height references], holding a spot over the ground or water by employing a calculated position using the INS and GPS. Unlike the Harrier, the aircraft also does not require water injection for hovering.

"Where we have a lift fan in our B-model, the A-model and C-model have a fuel cell. Thus, the weight difference is not significant and there is only a small penalty



for having the extra weight in the airplane; performance is very similar between the 'As and 'Bs. The C-model is a bigger jet; it has a much larger, folding wing and carries more fuel, but it also has a very similar engine, so there are very minor performance differences between the 'B and 'C too.

"By design, all three variants function in a similar manner, including the combat systems, and that is good for pilots because they can seamlessly fly two different models. The main difference is recovering the aircraft back at the airfield or boat.

"Since the aircraft was conceptually new, one challenge for us, going to a low-observable aircraft that has phenomenal sensors that does all these really great things, was a mind-set shift in terms of employment. The more senior pilots had to be careful not to introduce different community-specific habits, having come from legacy aircraft, into the new F-35 community.

Whether you were a Harrier or Hornet pilot, it doesn't matter now – we are F-35 pilots. We do not want to have our past airframe experience hold any of us back.

"All our pilots love flying the Lightning II and there is no doubt in my mind that the Marine Corps has been going in the right direction with this programme. If we were tasked, we would be ready to deploy right now. Having flown this aircraft first-hand, there is not a single other aircraft I'd rather take to the fight for what we do."

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## What's next?

Block 3F will be the next major software upgrade. There will be numerous other upgrades and the new aircraft will continue to evolve, becoming better and better with time. The unit remains focused on FOC (targeted for August 2017), then deployments, and will continue attending exercises, including Red Flag and more. The F-35B will stay the course to be groomed for amphibious assault ships and employed in MAGTF/MEU operations while deployed. The Marines are also going to receive F-35Cs within the next few years, for carrier air wing battle group integration, or use in the land-based expeditionary role. Each USMC F-35C unit is slated to have a total of ten jets, flown in a role similar to that in which the USMC F/A-18A/C/D Hornet community currently deploys. The long-term plan calls for the F-35B/C to replace all USMC EA-6Bs, AV-8Bs and F/A-18s, with a planned procurement of 353 F-35Bs and 67 F-35Cs for the Corps. On June 29, 2016, VMFA-211 'Wake Island Avengers' was the second operational USMC squadron to transition to F-35Bs (it was also the first AV-8B VMA unit to make the transition). Although prone to change, the next planned Marine Corps squadrons to receive the F-35 at the time of writing are VMFA-122 ('Bs), VMFA-314 ('Cs), VMFA-311 ('Bs) and VMFA-214 ('Bs). VMFA-122 is scheduled to move to Yuma and VMFA-121 should move to Japan in 2017.

