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# F-35 LIGHTNING II ON THE PROWL AS IT TARGETS CANADA'S FFCP COMPETITION

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The Lockheed Martin F-35 Lightning II / Joint Strike Fighter (JSF), is the only 5th Generation fighter jet competing for Canada's Future Fighter Capability Project (FFCP).

This is key point that should not be understated as the F-35 offers unmatched, cutting-edge technology that is particularly important in modern and emerging multi-domain warfare. Acquisition of the F-35 would also provide Canada a critical first step for NORAD modernization, domain awareness and true national and Arctic security.

Canada has been a partner on the F-35 JSF program since 1997 when the Government committed \$10 million to join the "Concept

Demonstration" phase. In 2002 Canada invested another \$150 million to participate in the System Development and Demonstration phase which provided more than 10 years of initial development work for Canadian industry. Participation in the program has given Canadian companies the opportunity to compete for design, development, production and sustainment contracts on the F-35 aircraft and associated systems. Collectively these contracts have provided almost \$2 billion to Canadian businesses, and that's all before Canada has bought a single jet.

Now, Lockheed is proposing the F-35A CTOL (Conventional Take Off and Landing) variant as the optimum solution for FFCP. CDR readers will be aware that we've covered much of the F-35's capabilities in previous reports, so what we'd like to do here is offer a discussion on the merits of 5th Generation, provide an update on the program, and look at industrial successes, as well as the suitability of the F-35 for Canada.

## **WHY A 5<sup>TH</sup> GENERATION FIGHTER JET?**

One discussion point that is often debated is the difference between a 4 - 4.5 Generation jet and a 5th Generation jet. To explain this, CDR spoke with Lieutenant-Colonel Kendall Spencer, an F-16 pilot with the U.S. Air Force, "In recent years the Air Force has been able to give updates to 4th Generation aircraft so they can work in the current and near future environment and be able to interface with the more advanced generational technologies that we have available to us, but there are constraints as to what they are. The technological edge that the U.S. and Canada and our other major allies have enjoyed is because we've been able to wrap our brains around new technologies and figure out where and how we need to employ them faster than other people,"

CDR also talked to Colonel Randy Gordon, a U.S. Air Force pilot who has flown the F-22 Raptor, "Having flown a 5th Gen jet, I can tell you that I get it. Both the F-22 and the F-35 are a different class of fighter - these airplanes bring capability that no others do. The leap from first to third Generation was somewhat incremental, but the leap from a 4th Gen to a 5th Gen jet is pretty dramatic. Having had the experience to fly a 5th Gen jet, I'd say a better way to describe this issue is to say: '... what can I do that was not possible in previous generations, and what really matters on the modern battlefield?' There are things that 5th Gen can do that 4th Gen was never made for at all. 5th Gen jets are exceptionally good at situational awareness and at stealth, and that brings capabilities. I think universally you will never find a pilot that went to the F-35 and wants to go back to an earlier generation jet, particularly for high-end threatening missions."

## **MORE THAN SIMPLY A CF-18 REPLACEMENT**

It is important that we look at FFCP as more than simply a replacement of the CF-18 Hornet. It should, in fact, be considered in the context of Canada's defence policy - Strong, Secure, Engaged - which speaks about a prioritization of NORAD and its modernization. The defence policy states that Canada will "act as a responsible and value-added partner in NORAD," and "field advanced capabilities to maintain advantage over adversaries."

FFCP will see the delivery of a new fighter begin over 40 years after the initial CF-18 arrived, so Canada's investment in this future fighter will need to be relevant for a similar period of time and will need to be upgraded along the way.

The imperative for this is based on the re-emergence of the Great-Power competition, and the realization that Russia and China have developed a new generation of advanced aircraft and weapons which have reduced the tactical and even strategic superiority once enjoyed by the West. One only has to read the news to see that Russian heavy bombers conducted 48 air patrols in 2019 - a number of which were intercepted by NORAD fighters (including Canada's CF-18). Furthermore, the threat posed by North Korea and its land and submarine-based ballistic and cruise missiles should not be underestimated.

U.S. Air Force General Terrence O'Shaughnessy, Commander of the United States Northern Command

(NORTHCOM) and Commander of NORAD spoke before the U.S. Senate Armed Services Committee in February. He said, "The Arctic is the new frontline of our homeland defence. Russia has steadily expanded its military presence in the region and, by fielding advanced, long-range cruise missiles - to include land attack missiles capable of striking the United States and Canada from Russian territory - Russia has left us with no choice but to improve our homeland defence capability and capacity."

O'Shaughnessy added, "2019 also saw continued expansion of Russia's military infrastructure in the Arctic. Throughout the year, Russia lengthened existing runways and built new ones at multiple airfields in the high north. Like the Russians, China also continues to invest heavily in the Arctic, determined to exploit the region's economic and strategic potential as a self-proclaimed 'near Arctic' nation... In order to effectively defend the homeland, USNORTHCOM and NORAD have developed a Homeland Defense Design [HDD] consisting of three main elements: a layered sensing grid for domain awareness, an adaptive architecture for joint all-domain command and control [JADC2], and new defeat mechanisms for advanced threats, including cruise missiles, ballistic missiles, hypersonic weapons, and small unmanned aerial systems. These three elements are vital to deterring and defeating advanced threats to the homeland, and USNORTHCOM and NORAD are moving with a sense of profound urgency to bring these capabilities into the fight."

## **THE ABILITY TO COVERTLY PATROL**

Domain Sensing involves a layered sensing grid in all domains which can detect and track threats from their point of origin; while JADC2 is an adaptive architecture capable of fusing a myriad of sensors across the globe into accurate decision quality threat information at the speed of relevance. Effective Defeat Capabilities encompasses the ability to deploy defeat mechanisms capable of neutralizing advanced weapon systems in order to defend the country and the continent.



One can safely say the F-35 weapon system has the best capacity to fit within each of the HDD categories that General O'Shaughnessy noted. As a platform with an operational mission radius greater than 700 nautical miles in low observable configurations, and an internal fuel capacity of more than 18,000 pounds, the F-35 has the ability to covertly patrol, monitor and surveil the vast regions of the warming Arctic and expanding Canadian Air Defence and Identification Zone (ADIZ).

The F-35's Distributed Aperture System (DAS) is uniquely effective in locating and tracking Ballistic Missiles, while the jet's AESA radar is proven in its ability to track low flying cruise missiles. All of this fused, target-quality information can be shared via satellite communication (SATCOM) and F-35 downlink stations, which are included in Lockheed Martin's FFCP bid. Furthermore, the F-35's large and

growing inventory of weapons provides it with the ability to engage threats while undetected, and that helps to ensure mission success.

It is interesting to note that of all the major allies, whether they be Five Eyes nations (with the exception of New Zealand which does not have a fighter force), or NATO, almost every country acquiring a new fighter, is opting for the F-35. Within the context of the Arctic region specifically, the United States, Norway and Denmark (via Greenland) all fly the F-35, and are bolstered by F-35s in service with the UK and Japan.

## **ALREADY TESTED IN COMBAT**

The F-35 program is making great strides in competitions, the delivery rate of jets, operational use and reduction of cost. To date, there are 14 nations in the F-35 program of record, with 9 nations operating on home soil. Eight services have declared Initial Operational Capability and four services – USAF, USMC, Israeli Air Force, and the United Kingdom - have so far conducted combat operations with the F-35. There are currently 23 bases worldwide which are operating the F-35 (three of which are ships); this will grow as Eielson AFB has received its first two jets this year.

Lockheed has now delivered over 500 F-35s to customers around the world, with the Block 3F version currently rolling off production lines. The next evolution of the jet is Block 4, which adds a host of advanced capabilities and enhancements facilitated by a Technology Refresh 3 (TR3) hardware package which includes a new integrated core processor with greater computing power and an enhanced memory unit. Broadly stated, the Block 4 upgrade will result in new or improved capabilities in the radar and electro-optical system, electronic warfare updates, logistic and support changes, interoperability and networking changes, cockpit and navigation upgrades, integration of new weapons and more. According to Lockheed, the TR3 hardware insertion is planned for Lot 15 aircraft, with software implementation planned for the following year.

2019 provided a number of highlights for the F-35 program - notable are USAF deployments to the European Command and Central Command; integration of Belgium into the program; a flight evaluation for Switzerland's fighter requirement; and a reduction in cost for aircraft built in Low-Rate Initial Production (LRIP) Lots 12-14, which equates to a 70% cost reduction from LRIP 1. In all, 134 F-35s were delivered to customers in 2019.

In April 2019, the F-35 was deployed to the CENTCOM Area of Responsibility for its first operational tasking. Initially, the mission was supposed to last only six months. However, CENTCOM realized, "We can't live without the F-35," and pushed up the second operational mission six months ahead of schedule. For more than a year, the F-35s have conducted operational missions 24/7, through holidays, challenging environments and currently, amidst COVID-19. After more than 1,300 sorties and 6,900 flight hours, the F-35 has maintained 80.7% mission-capable rate while deployed.

## **1000 PILOTS TRAINED ON F-35**

Greg Ulmer is Vice President and General Manager for the F-35 Program at Lockheed Martin and for this report he talked to CDR about recent developments, “We’ve now trained over 1,000 pilots on the F-35 program and we’ve reached 260,000 flight hours for the fleet. In January, Luke Air Force Base had a significant milestone of 56,000 sorties flown from the beginning of training, so that’s quite an accomplishment for the program... We delivered the first initial Block 4 capability from an Auto GCAS



[Ground Collision Avoidance System] perspective, so all three variants today have Auto GCAS embedded in them. We also settled on Lots 12 through 14 - which I call a block buy relative to that - we were able to get that CTOL F-35A model to \$80 million dollars or less. In Lot 14 we’ve actually got to \$78 million for that A-model airplane; and we are on a trajectory to reach a cost per flight hour of \$25,000 by 2025.”

On 31 January, Poland concluded its fighter acquisition program with the signing of a Letter of Offer and Acceptance between the U.S. and Polish governments for 32 F-35A CTOL variant jets, with initial deliveries beginning in 2024 and in-country deliveries in 2026. According to Lockheed, Greece, Romania and Spain have also expressed interest in the F-35.

## **FLY-OFF IN FINLAND**

In early 2020 Lockheed Martin sent two F-35s to Finland for flight demonstration trials as part of that country’s HX Challenge which served as an opportunity for candidates to demonstrate their respective capabilities. Billie Flynn, a former RCAF fighter pilot and Lockheed Martin F-35 test pilot, flew during the HX Challenge and shared his thoughts with CDR on parallels to Canada’s program.

“The topography of Pirkkala Air Base and that part of Finland looks just like North Bay, Ontario. The February timeframe that we had was essentially going to be as cold as North Bay winters, with all the considerations of icy runways and managing bad weather like we would have expected operating in Canada, and potentially even colder, more like Cold Lake, Alberta. To me, it was an excellent chance to do an evaluation to preview what operations would be like in a Canadian climate. Flying during the HX

Challenge goes along with confidence building from the second winter of the Royal Norwegian Air Force flying their F-35s in winter operations.”, explained Flynn.

As noted previously, a number of Arctic nations are fielding the F-35. The F-35 has also operated in Iceland as part of NATO’s Air Policing mission. This mission is responsible for monitoring the airspace in and around Iceland while ensuring that all air traffic is identified. Because Iceland has no military, NATO allies, including Canada, provide this periodic service on a rotating basis. In 2019 the Italian Air Force’s 32nd Wing deployed six F-35 aircraft to Iceland for the first time; this deployment was followed in early 2020 with the Royal Norwegian Air Force who deployed four F-35 fighters for the same air policing mission.

“We’re hearing that once the F-35 deploys, it’s really finding its groove in multiple domain operations, or joint all domain operations,” said Ulmer. “The experience in CENTCOM and the experience that we have with our FMS [Foreign Military Sales] customers - what we’re hearing is that multi-domain operational aspect of the F-35, the gathering with its data sensor suite, the integration and data-fusing of that information, and the ability to network offload that information to the elements around air, land and sea - it’s very, very powerful in that regard, so that’s what we hear coming back from our customers in that environment.”

## **F-35 BENEFITS FLOW TO CANADIAN INDUSTRY**

On 11 December 2006, the Government of Canada signed a Production, Sustainment and Follow-on Development Phase Memorandum of Understanding (PSFD MOU) with the F-35 Program. The objective of the PSFD MOU is to establish a framework to allow the partner countries to cooperatively produce, sustain and do follow-on development of the F-35.

The PSFD MOU did not commit Canada to buy the F-35, but it did establish the conditions for its on-going participation in the F-35 Program. The competitive approach to the MOU helps to ensure that the Program has access to the best technologies at the best prices. Over the past 15 years Canada has been awarded approximately 200 projects in the F-35 Industrial Participation Plan, and that has yielded benefits to Canadian industry.

Companies like Gastops Limited of Ottawa, developed debris monitoring sensors for use on the F135 engine that powers the F-35. Their F-35 success allowed them to secure additional work on the Pratt & Whitney PurePower engines that are used on the Airbus A320neo and A220 jets.

At Magellan Aerospace, there are more than 200 employees across Canada who support the F-35 program. The company produces F-35 components at three Canadian facilities in Winnipeg, MB; Kitchener, ON; and Haley, ON.

## **MAGELLAN NOW AN ESTABLISHED F-35 SUPPLIER**

Scott McCrady, Director, Corporate



Business Development and Canadian & US Government Affairs at Magellan, told CDR, “Canada has been an industry partner on the F-35 program for more than 15 years and from Magellan’s perspective the program is performing well and living up to the expectations of the industry partners. The F-35 program has delivered on commitments to introduce new advanced manufacturing technology into Magellan’s operations. Through early adaptation of the various technologies necessary to produce F-35 components, Magellan is now an established and integral F-35 supplier.”

The company’s casting facility in Haley has been producing complex castings for gearboxes and oil tanks for two F-35 variants since 2008. In Kitchener, various titanium machined components have been in production since 2003 for the three variants of the F-35 aircraft. Notably, the Kitchener operation was the first international partner to deliver non-U.S. manufactured components to the F-35 program and has therefore been able to make significant investments in both equipment and technology.

Magellan’s Winnipeg operation is delivering lift fan components for the F-35B STOVL variant, composite panels for the F-35A and F-35C, and complete shipsets of horizontal tail assemblies from a purpose-built advanced composite manufacturing centre. In 2020, the horizontal tail manufacturing line will be delivering full rate production, facilitated by a second precision milling machine and a new paint facility.

## **F-35 WORK A BOON FOR AVCORP**

Another leading Canadian aerospace company providing high-tech components for the F-35 is Avcorp Industries. Headquartered in Delta, BC, the company specializes in aerostructures and maintenance, repair and overhaul. Amandeep Kaler, is Group Chief Executive Officer at Avcorp. He told CDR, “Work from the F-35 program as a whole is the biggest part of our company. Our Canadian facility is focused on large complex integrated structures; it is here where we are the single source producing the outboard wing for the F-35C.”

He explained, “That production rate is set to triple in the coming years. Our California facility is focused on complex composite parts and does complete wing skins for all F-35 variants. We have developed a Canadian supply chain as part of our F-35 efforts, and the coming years will see an increase in jobs as we ramp up to high rate production. The work that we’ve done on the F-35 has allowed us to build our profile and that’s allowing us to bid on work projects across the industry which are much higher in complexity than we would have otherwise been able to do.”

Addressing FFCP, Lockheed's Ulmer said, "Canada has been a partner for a long time on the F-35, so there's quite a bit of work we've collectively done to support the F-35. For example, from an industry perspective, every airplane that comes off the line today has Canadian content - that's a little over \$2 million dollars per airplane, and about 170 parts per airplane. We'd really like to see that partnership all the way through, relative to the intent I think that was created at the beginning such that Canada actually procures."

He explained, "With that said, I understand from a sovereign perspective that Canada wants to have a competition and make a selection from a requirement point of view and a best value point of view. I think Lockheed has done due diligence to support from a partnership perspective that relationship, meeting our end of the commitment, and we'd like to see that through, such that Canada sees the value we've had, the value we can have going forward, and meet the advanced mission requirements expected for this platform. I think the F-35 is key to doing that so we are ready to submit a fully compliant comprehensive proposal for the Canadian program."

## **\$2 MILLION OF CANADIAN CONTENT ON EVERY F-35 PRODUCED**

As Ulmer mentioned, there is Canadian content on every F-35 airplane coming off the production line. Current forecasts expect upwards of 3,000 F-35s being built over the lifetime of the program, so in relative terms, the F-35 is at the beginning of that build period. The resulting worldwide F-35 supply chain and sustainment infrastructure will undoubtedly allow Canadian industry the opportunity to join or continue to be part of a maturing global enterprise, which is an order of magnitude larger than any other competitor. As well, over the long-term, there may be other development opportunities to upgrade the aircraft's technology, so such work would represent additional opportunities to Canadian industry.

"I would offer that the F-35 has a bigger technology aperture in terms of opportunities than the 4th Gen competitors," said Ulmer. "The rule of thumb is 30% of dollars are on acquisition, and 70% are on life-cycle or sustainment costs. That means there's going to be a lot of opportunity, if Canada truly procures the airplane, to have that sustainment opportunity on the backside over a very long run. It's very much like what you see with the legacy C-130; you'll see a very broad opportunity base for industrial participation on F-35."

If, as we've discussed here, we consider the emerging security threats to Canada and North America, it is apparent that there needs to be a coordinated and cohesive approach to defence. And arguably, F-35 is best suited for that task and it's important to reiterate that the program is at the beginning of a manufacturing cycle that will span at least another three decades. The service life will be even longer.

The decision on FFCP will determine Canada's ability to defend its sovereignty in the years to come so the government must get it right. What it all comes down to is this - Canada must consider the longevity of the systems it procures, and the ability of those systems to work within joint all-domain constructs, while also being lethal and survivable. From what we've learned, F-35 could very well fit the bill.

***Joetey Attariwala is CDR's Senior Staff Writer and Aviation Editor***