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One Dead Pilot

Single-Engine F-35 a Bad Choice for Canada's Arctic

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One Dead Pilot

Single-Engine F-35 a Bad Choice for Canada's Arctic

1. Introduction

Air Canada Flight 001 took off from Toronto on May 28, 2012, destined for Tokyo with 325 people on board. Just 500 metres into the air, an engine failed and the Boeing 777 returned to Toronto. The Transportation Safety Board later determined the engine failure was the result of a manufacturing fault, which had caused damage that mechanics failed to detect during a routine inspection.[1]

The engine failure on Air Canada Flight 001 is highly relevant to a decision the Harper government is currently facing. Canada's CF-18 fighter jets are 27 years old, on average, and need to be replaced, not least because of concerns about metal fatigue.[2] The first step in the replacement process involves deciding whether to proceed with the government's previously planned non-competitive purchase of Lockheed Martin F-35s.[3]

There are many reasons to be concerned about the F-35, including its still incomplete and unproven character, its relatively slow speed and limited manoeuvrability, and the considerable cost risks associated with its acquisition, operation and sustainment.[4] This report focuses on just one reason for concern.

The passengers and crew of Air Canada Flight 001 were never in danger, because the Boeing 777 has two engines. The F-35 has only one engine.

This fact alone renders it problematic for use in Canada's Arctic and extensive maritime zones.

2. History

A. CF-104 Starfighter: The 'Widow Maker'

Canada operated the CF-104 Starfighter from 1961 to 1987. The aircraft was designed by Lockheed Corporation, the predecessor of Lockheed Martin — the company that now manufactures the F-35. The Starfighter had small, thin wings that gave it a high "wing loading", which reduced manoeuvrability and made the aircraft susceptible to stalling.[5]

The Starfighter had just one engine, any failure of which would lead to a crash. The single engine also made it vulnerable to crashes involving bird strikes. As a tactical strike aircraft, the Starfighters flew fast at low altitudes, exacerbating this risk.[6] During the 26 years of operation, about one-quarter of Canada's 110 Starfighter crashes were attributed to bird strikes.[7]

Although Canada's Starfighters never saw combat, 39 Canadian pilots lost their lives while flying these planes.[8] Nearly half the fleet (110 out of 239 aircraft) was also lost.[9] But it was the significant number of casualties that earned the aircraft the nickname the "Widow Maker".[10]

B. CF-18 Hornet: Chosen for Its Twin Engines

In March 1977, the Canadian government launched a competition to select a new fighter to replace the CF-104 Starfighter as well as the CF-101 Voodoo, a twin-engine jet operated by Canada's NORAD air defence squadrons.[11] Five bids were received in response to the government's request for proposals, two of which were shortlisted: the single-engine F-16 and the twin-engine F-18.[12] The three other bids — the F-14, F-15, and Tornado — all had twin engines, but were eliminated from the competition because they exceeded the Canadian government's budget for the procurement.[13]

Between the two shortlisted aircraft, the Canadian military clearly preferred the F-18 for its twin engines.[14] As early as November 1978, *The Globe and Mail* reported: "The lack of a second engine as a backup for long-distance continental air defence applications has caused concern among the military."[15] In March 1980, the same newspaper reported: "Most pilots who are willing to discuss the matter say they prefer the F-18" because "the aircraft's two engines are safer than the F-16's single engine over the barren

An All-Too Familiar Scene in the 1960s, 70s and 80s: A Crashed F-104 Starfighter

North".[16] The next month, *The Globe and Mail* again reported that the F-18 "is preferred by Canadian Forces pilots on the ground that for long Arctic patrols two engines would be better than one."[17]

A similar preference was expressed in the United States with respect to fighter operations over the ocean. While the US Air Force procured the F-16, the US Navy insisted on a twin-engine aircraft — the F-18. The following excerpt from a Congressional sub-committee hearing is illustrative:

> *Chairman McClellan.* The plane the Navy rejected — the F-16 — was a one-engine plane, was it not?
>
> *Senator Goldwater.* That is right.
>
> *Chairman McClellan.* And the Navy insists, I believe, that their planes have two engines.
>
> *Senator Goldwater.* Well, any pilot can understand that.[18]

Canada announced its decision in favour of the F-18 on April 14, 1980.[19] The announcement was accompanied by the following explanation from General Paul Manson, the head of Canada's procurement team: "If you have

Twin-Engine CF-18 Hornet *(Photo Corporal Pierre Habib, 3 Wing Bagotville. © 2012 DND-MDN Canada)*

a flame-out while on patrol with the F-18, at least you can be sure of getting home on the other engine."[20] Manson was clear that Canada would have lost more aircraft to accidents had it chosen a single-engine plane:

> Because of the lower attrition expected with the F-18, there would be more of them left in the fleet over a period of time than if F-16s had been purchased, even at the higher F-16 numbers available because it was the cheaper airplane of the two. This loss would not have shown up immediately but over the lifetime of the aircraft, it would have been very significant.[21]

3. Comparing Safety Records of Single and Twin-Engine Fighter Jets

A. Safety Record of the F-16 Versus the CF-18

Thirty-four years after Canada selected the twin-engine CF-18 over the single-engine F-16, it is now possible to compare the operational safety records of the two aircraft. Since 1979, the US Air Force has lost 297 of its fleet of approximately 1300 F-16s in crashes.[22] Although information on some of the

Single-Engine F-16 'Lawn Dart'

crashes is limited, at least 76 and potentially as many as 166 were caused by engine failure.[23] The Norwegian Air Force has lost 16 of its fleet of 72 F-16s to crashes. At least six of the crashes involved engine failures, three of which were caused by bird strikes.[24]

With this safety record in mind, it is no surprise that airmen called the F-16 the "lawn dart".[25]

In 2012, NDP defence critic Jack Harris asked how often CF-18 pilots had shut down an engine in-flight due to safety concerns. The Department of National Defence (DND) responded that an engine had been shut down on 228 occasions between 1988 and 2012.[26] At the same time, DND noted that shutting down an engine "is a precautionary measure" and that there "is no way to know if the engine would actually have failed or not, had it continued to be used."[27] Harris responded:

> They're not shutting down the engine because they think it's a great idea. They're shutting it down because they have to. This means 228 times they had an opportunity of getting a plane back to base when it could have resulted in an engine failure of significant proportions.[28]

At the very least, having twin engines enables CF-18 pilots to shut down one engine without crashing the plane. This might explain why airmen continue to refer to the CF-18 by its official name, the "Hornet", rather than adopting a pejorative nickname.

B. US Air Force Statistics on Engine-Related Crashes

Thirty-four years ago, General Dynamics — the maker of the F-16 — assured the Canadian government "that its single-engined aircraft is just as safe as any twin-engined aircraft."[29] Since 2010, when the Harper government announced its intent to purchase F-35s, it has been at similar pains to stress the safety of single-engine jets.

When then Defence Minister Peter MacKay was asked whether he was concerned about procuring a fighter jet with only a single engine, which could fail and force pilots to eject over the ocean or Arctic, he replied in just two words: "It won't."[30] An unnamed "senior government official" added that the F-35 engine is "newer technology so it is extremely robust" and that statistical studies show "no clear advantage" to twin-engine planes.[31]

Reportedly, both the Harper government and Lockheed Martin claim there is no statistical evidence to indicate single-engine fighters are any less safe than twin-engine fighters.[32]

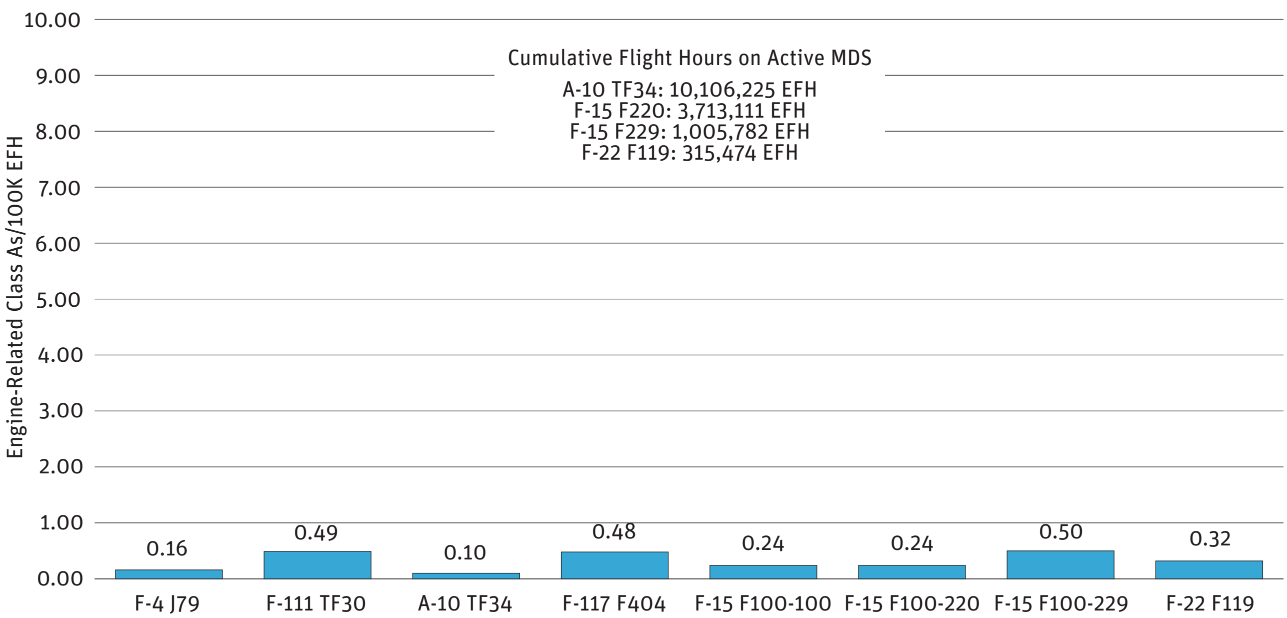
In reality, such statistical evidence is readily available from the website of the US Air Force Safety Center. Two figures detail engine-related "Class A Flight Mishaps", i.e., accidents in which the pilot and/or the aircraft are lost. Notably, the numbers in the documents do *not* include accidents caused by fuel starvation, failures of parts other than the engines, or bird strikes — even though bird strikes pose a serious risk, especially for aircraft flown fast and low.[33]

Figure 1 provides the engine-related "Class A Flight Mishap Rates" (FMRS) for twin-engine fighter/attack aircraft in current and recent service with the US Air Force.[34]

Figure 2 provides the engine-related FMRS for single-engine fighter/attack aircraft in current and recent service with the US Air Force.[35]

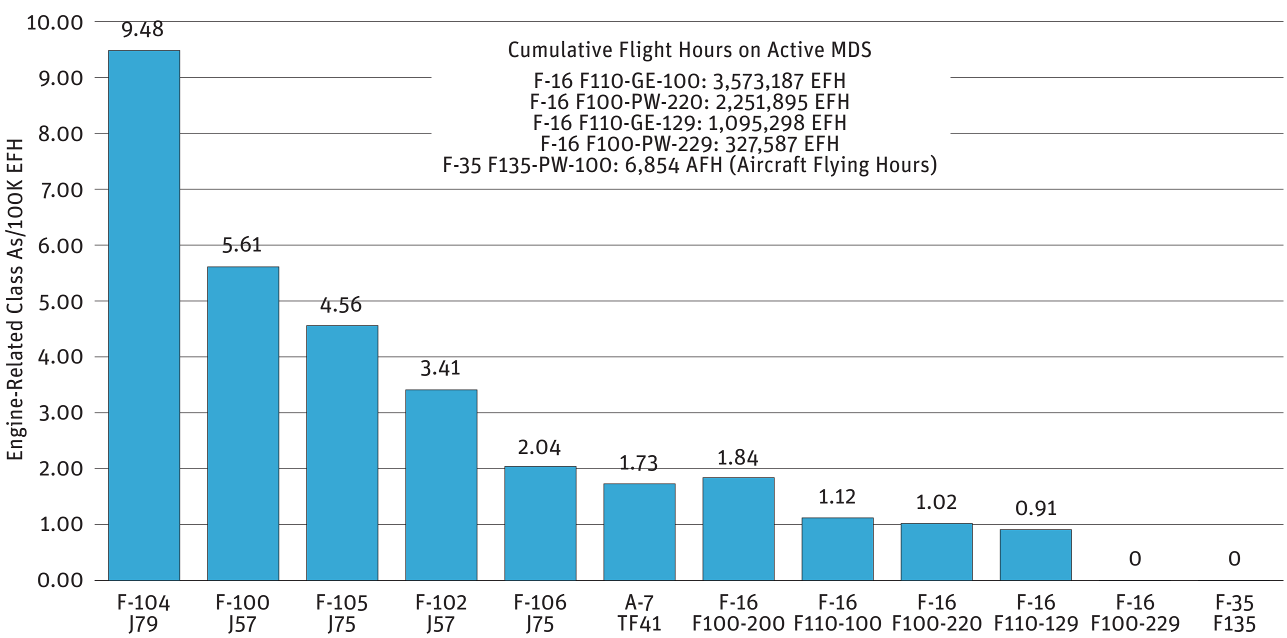
As the documents illustrate, there is a significant different in the frequency of engine-related catastrophic accidents involving twin-engine versus single-engine fighter jets. The two versions of the twin-engine F-15 in current service have FMRS of 0.24/100,000 and 0.50/100,000 Engine Flight Hours (EFH), respectively. The twin-engine F-22 has an FMR of 0.32/100,000

FIGURE 1 USAF Engine-Related Fighter/Attack Class A Flight Mishap Rates For Twin Engine Aircraft, As of 31 March 2014



Source http://www.afsec.af.mil/shared/media/document/AFD-140520-050.pdf

FIGURE 2 USAF Engine-Related Fighter/Attack Class A Flight Mishap Rates For Single Engine Aircraft, As of 31 March 2014



Source http://www.afsec.af.mil/shared/media/document/AFD-140520-049.pdf

EFH. The documents, it should be noted, do not include data on the F-18, which is flown by the US Navy and not the US Air Force.

In comparison, the four versions of the single-engine F-16 in current service have FMRS of 1.12/100,000, 1.02/100,000, 0.91/100,000 and 0.00/100,000 EFH, respectively. The latter number can be at least partly explained by the late-production version having accumulated just 327,587 EFH, as compared to 3,573,187 EFH, 2,251,895 EFH, and 1,095,298 EFH for the earlier three versions.

The documents do show improvement in engine reliability over time. The single-engine F-104 (the American version of the CF-104 Starfighter), introduced in 1958, had an FMR of 9.48/100,000 EFH. The first version of the single-engine F-16, introduced in 1978, had an FMR of 1.84/100,000 EFH.

Just as significantly, however, early twin-engine fighters had much better FMRS than the single-engine F-16s in later service. The twin-engine F-111 Aardvark, which was in service from 1967 to 1996, had an FMR of 0.49. The twin-engine F-4 Phantom II, which was in service from 1961 to 1996, had an FMR of just 0.16.

When it comes to saving the aircraft and pilot after an engine failure, the evidence from the US Air Force Safety Center clearly disproves assertions that single-engine aircraft are as safe as twin-engine aircraft: Having a second engine does make a difference.

4. Replacing the CF-18

The F-35 program began in the early 1990s as an effort to develop a "strike fighter" that could — in three different versions built around a common airframe — serve the US Marines, US Air Force, and US Navy.[36] The needs of the US Marines included short take-off and vertical landing (STOVL) which could only be provided with a single-engine design.[37] Consequently, because of the overarching decision to have a common airframe, the US Navy and US Air Force were forced to accept the same single-engine design for their versions of the F-35. This outcome resulted despite the fact that a single engine was less than ideal for the US Navy, which procured the F-18 in the 1980s precisely because the aircraft's second engine provided better over-ocean safety than any single-engine plane.[38]

In this context, it is also noteworthy that the US Air Force accepted the single-engine design for the F-35 alongside an advanced twin-engine fighter. Indeed, the US Air Force plans to use its larger, faster, more manoeuvrable and safer F-22 to protect the F-35 from enemy fighters. As General Michael

F-35's Single Engine Driven by US Marines' Need for Short Take-off and Vertical Landing

Hostage, the head of Air Combat Command, told the *Air Force Times*: "The F-35 is not built as an air superiority platform. It needs the F-22."[39]

Canada joined the F-35 program in 1997 when it signed on to the "Concept Demonstration Phase". Canada later agreed to become a "Level-Three Participant", contributing a total of $606 million to the development of the aircraft[40] even though it had no interest in the STOVL version, no need to accommodate the US Marines by accepting a single-engine design, and no plans for a parallel purchase of twin-engine fighters to protect the F-35.

In July 2010, the Harper government announced it would purchase 65 of the conventional landing version of the F-35, the F-35A.[41] However, it did not sign a contract. To this day, Canada is not contractually obligated to buy any F-35s, and retains the freedom to opt for another model of plane without any penalty or loss of deposit.[42]

That freedom served Canadians well when, in April 2012, Auditor General Michael Ferguson issued a report criticizing DND for having failed to "exercise due diligence in managing the process to replace the CF-18 jets."[43] The Harper government responded by suspending the F-35 procurement and ordering the Royal Canadian Air Force to conduct an "Options Analysis" re-evaluating the F-35 and alternative aircraft.[44]

The Options Analysis is now complete, though it has not yet been made public.[45] DND's original "Statement of Requirements" for the CF-18 replacement has likewise never been released.[46] It is therefore unclear as to whether the single-engine versus twin-engine issue has been carefully examined, as this report seeks to do. It is significant that, with the exception of the F-35, all of the aircraft considered in the Options Analysis have two engines.

5. Reliability of Modern Jet Engines

According to *The Globe and Mail*, the Harper government insists that the F-35's single engine is more reliable than previous generations of jet engines.[47] Although that may be true, it should not be the only consideration. Thus far, the Harper government has sidestepped the key question of whether a modern single-engine jet is as safe as a modern twin-engine jet, especially in the Arctic and over Canada's extensive maritime zones.

The answer to this question is not to be found simply by looking at fighter jet aircraft. As was shown above, the single-engine F-16 has proven to be more reliable than the earlier single-engine F-104 but less reliable than the twin-engine F-15 and F-22.[48] Saab's single-engine Gripen fighter jet has performed well, with not one engine-related crash since it joined the Swedish Air Force in 1997. But with less than 250 Gripens in service, this may not be the best indication of reliability.

More telling with regard to the necessity of twin engines is the record of the engines on modern commercial airliners — engines that share much of the same technology and log far more hours than the engines on fighter jets. The Boeing 777 is one of the safest aircraft in the world, with approximately 1000 operating today and not a single death attributed to mechanical failure during two decades of service. That record has a great deal to do with the fact that the Boeing 777 has more than one engine. In addition to the incident involving Air Canada Flight 001, as outlined in the introduction to this report, consider these other incidents *within the last year*:

June 1, 2013: An Emirates Airlines Boeing 777 flying from Dubai to Munich had to shut down an engine and divert to Trabzon, Turkey, where it landed safely.[49]

July 2, 2013: A Korean Air Boeing 777 lost an engine over the Bering Strait after an improperly manufactured gear-shaft fractured. Despite the remote

Boeing 777: One of the Safest Aircraft in the World

location, the plane was able to land safely at Anadyr, Russia, 550 kilometres away.[50]

July 18, 2013: A United Airlines Boeing 777 was climbing out of Houston en route to Amsterdam when an engine failed; the aircraft returned safely to Houston.[51]

July 21, 2013: A Pakistan International Airlines Boeing 777 flying from Islamabad to London landed safely in Moscow after an engine stalled and had to be shut down.[52]

Aug 7, 2013: A Transaero Boeing 777 developed engine problems shortly after leaving Moscow for Barcelona. The crew shut the engine down and returned safely to Moscow.[53]

Sept 8, 2013: A United Airlines Boeing 777 experienced engine trouble shortly after leaving Beijing for Newark; the aircraft returned safely to Beijing.[54]

Oct 20, 2013: A KLM Boeing 777 en route from Osaka to Amsterdam landed safely in Stockholm after turning off one engine.[55]

Dec 13, 2013: An All Nippon Airways Boeing 777 lost thrust from one engine after leaving Tokyo en route to Fukuoka; the aircraft returned safely to Tokyo.[56]

April 22, 2014: A United Airlines Boeing 777 travelling from San Francisco landed on a single engine at London's Heathrow Airport.[57]

April 27, 2014: An Austrian Airlines Boeing 777 flying from New York to Vienna landed in Frankfurt on one engine.[58]

April 30, 2014: An Alitalia Boeing 777 flying from Rome to Miami had to shut down an engine an hour from its destination, where it landed on a single engine.[59]

Most of these incidents were not considered newsworthy because the planes were able to land safely — thanks to the second engine. Other makes and models of civilian airliners have similar records.

Given the number of times in the past year when Boeing 777s had to operate using only one engine, it is difficult to imagine anyone flying on a single-engine airliner, especially above an ocean or in the Arctic where there is little possibility of gliding to an emergency landing. It is equally difficult to imagine any government approving a single-engine airliner for use above oceans or in the Arctic, regardless of how reliable engines become. For anyone concerned about the safety of Royal Canadian Air Force pilots, the same logic must apply to the procurement choice between single-engine and twin-engine fighter jet aircraft.

6. Fighter Jet Aircraft Do Not Glide Well

On rare occasions, civilian airliners have lost power to both engines because they ran out of fuel or experienced a double bird-strike. In several of those instances, the planes have been able to glide to safe landings, either on runways — as in the case of Air Canada Flight 143 (the "Gimli Glider") in 1983[60] and Air Transat Flight 236 in 2001[61] — or, in the case of US Airlines Flight 1549 in 2009, on the Hudson River in New York City.

Like modern civilian airliners, the F-35 is an "all-electric", computer-reliant aircraft that cannot be controlled in the absence of power. To guard against this risk, most civilian jets are equipped with a ram air turbine that, when deployed in an emergency, generates electricity from the movement of air past the plane. The Boeing 787 is an exception in that it relies on lithium-ion batteries — batteries that, because of concerns about the possibility of fires, caused an extended grounding of the worldwide fleet of 787s in 2013.[62]

In what amounts to an admission that the F-35's single engine will sometimes fail or otherwise be disabled, Lockheed Martin is equipping the aircraft with a back-up lithium-ion battery — similar to those on the Boeing 787 but manufactured by a different company — to enable the pilot to operate the control surfaces in the case of a power loss.[63] However, given the F-35's small wings and high wing loading,[64] there is no real prospect of gliding it to safety if power is lost — unless it is already on a final approach or very near an airport.

The F-35's poor gliding ability is highly relevant in view of this country's geography. Canada has the second largest landmass of any country, and with just 35 million people, one of the lowest population densities. Canada has 1,467 airports, while the United States has 13,513 spread across a landmass that is seven percent smaller than Canada.

Canada also has the longest coastline of any country in the world and, off that coastline, a 200 nautical mile-wide exclusive economic zone. But unlike other large countries, Canada does not have any aircraft carriers. This means that Canada's fighter jets must operate from airports on land while surveilling and protecting one of the largest national maritime spaces on the planet. In the circumstances, a twin-engine fighter jet is the only responsible choice.

7. Engine Design Is Not the Only Determinant of Engine Reliability

As the story of Air Canada Flight 001's engine failure illustrates, engine design is not the only determinant of engine reliability. Quality control during the manufacturing process is also critically important. Jet-engine components experience extreme heat and pressure, and any quality issues in manufacturing can lead to catastrophic failure.

Already, quality control appears to be an issue with regard to the engine on the F-35. In March 2014, US Air Force General Christopher C. Bogdan, who leads the F-35 Joint Strike Fighter Program Office, testified before a Congressional subcommittee about "systemic" production issues at Pratt & Whitney, the company that manufactures the F-35 engine.[65] Bogdan complained that "far too often engine deliveries are interrupted by technical issues and manufacturing quality escapes resulting in product holds and material deficiencies that increase overall risk to meeting future production goals."[66]

Pratt & Whitney is headquartered in East Hartford, Connecticut, and a recent report in the *Hartford Courant* newspaper notes:

> Engine problems with the Joint Strike Fighter program have resulted in the fleet being grounded numerous times, while other quality and accounting issues have caused the Pentagon to withhold payments to Pratt & Whitney.
>
> Last year, the Pentagon grounded the fleet twice. In January 2012 the problem was a crimped hydraulic hose in an engine, and in February 2012 it was a crack that appeared on an engine's turbine blade.[67]

The Air Canada Flight 001 story also illustrates the importance of high-quality inspections and maintenance, as mechanics likely missed visible damage on the engine that later failed.

If F-35s are purchased by Canada, there will be no room for compromise on inspections and maintenance. There is no redundancy when it comes to the power plants on single-engine fighter jets, and when the planes are operated in the Arctic or over oceans, any cutbacks on inspections and maintenance will be paid for in lives. Yet recent budget cutbacks have resulted in reduced maintenance on Canada's existing fleet of twin-engine CF-18s.[68]

Moreover, major repairs and sustainment work on any Canadian F-35s would likely be done at specialized Lockheed Martin facilities in the United States, breaking any link between the pilots and the mechanics — and therefore, arguably, reducing the personal commitment to quality control that comes from knowing the people whose lives depend on your work.

8. Bird Strikes Remain a Problem

Although modern jet engines are designed with bird strikes in mind, they remain a problem for commercial and military aircraft — as the world was reminded in January 2009 when US Airways Flight 1549 was forced to land in the Hudson River after flying into a flock of Canada geese. Airports make a concerted effort to scare birds away from runways precisely because bird strikes, especially on takeoff, can be so disastrous.

The US Airlines incident was unusual because both engines were disabled by concurrent bird strikes. Logically, single-engine aircraft are much more susceptible to bird strikes because a loss of power can be caused by just one bird. A 2000 report on bird strikes on military aircraft tabulated 286 accidents leading to aircraft loss and/or aircrew death in 32 countries between 1950 and 1999.[69] Of the 286 bird-related accidents, 196 involved single-engine jets.

Bird strikes are a particularly important consideration for a "strike fighter" like the F-35, which will be flown fast and close to the ground. Bird strike rates increase dramatically when aircraft are close to the ground, especially at higher speeds.[70] Losses of the CF-104 Starfighter increased dramatically after that single-engine jet was re-tasked from high-altitude interception to low-altitude tactical strike. Indeed, about one-quarter of Canada's 110 Starfighter crashes were attributed to bird strikes.[71]

9. Other Arguments

According to *The Globe and Mail*, Canadian government officials claim that having a single engine makes the F-35 lighter and more manoeuvrable.[72] In actual fact, the F-35 is as heavy or heavier than its twin-engine competitors. The conventional landing version of the F-35 weighs in at 29,300 pounds;[73] the F-18A Super Hornet at 29,513 pounds;[74] the Eurofighter Typhoon at 22,000 pounds;[75] and the Dassault Rafale at 22,000 pounds.[76]

Nor is the F-35 more manoeuvrable than the alternative twin-engine aircraft.[77] In 2008, the RAND Corporation said: "It can't turn, can't climb, can't run."[78] According to the Pentagon's director of operational test and evaluation, the US government was forced to downgrade the requirements for the F-35's turn performance "from 5.3 to 4.6 sustained g's".[79]

Canadian government officials also argue that a single engine aircraft will be less expensive to maintain.[80] However, the operating and sustainment costs of F-35s are in fact higher than its twin-engine counterparts. For instance, according to information from the US government, the operating and sustainment costs of the F-35 are approximately twice those of the F-18A Super Hornet.[81]

10. F-35 Fleet Will Require Much-Improved Search and Rescue

Lockheed Martin argues that F-35s are appropriate for the Arctic because Norway flies F-16s in the Arctic, while the United States flies F-16s off aircraft carriers.[82]

CC-130E Hercules Employed for Search and Rescue in Canada Are Nearly Half a Century Old

Norway does indeed operate F-16s, and roughly half of that country is north of the Arctic Circle. However, Norway's Arctic is considerable smaller than Canada's and much more temperate — thanks to the effect of the Gulf Stream. Additionally, Norway has much better infrastructure than Canada in its Arctic, including numerous paved runways as far north as 78 degrees, at Longyearbyen on the Svalbard Archipelago. Crucially, Norway also has excellent search and rescue, including long-range search-and-rescue helicopters positioned in its Arctic, including on Svalbard.

The United States uses F-16s in Alaska and off aircraft carriers for one purpose only, namely, to use as mock enemy aircraft during training exercises. Significantly, a large portion of the United States' F-22 fleet is based in Alaska, providing twin-engine safety to fighter pilots operating in the American Arctic. The F-16s, in contrast, are kept relatively close to the airports and aircraft carriers, where search and rescue is readily available. Search and rescue is also quite good in Alaska, with dozens of search-and-rescue helicopters and planes distributed amongst the US Coast Guard, US Air Force, and Alaska National Guard.

In contrast, the search-and-rescue situation in Canada's Arctic can only be described as poor. No search-and-rescue helicopters or planes are based in the Arctic, and aircraft regularly fly 2,500 kilometres or more when responding to an emergency call from there. As a result, response times are slow: a problem for any search-and-rescue operation where time is of the essence, as is often the case in the North where extremely cold temperatures threaten the lives of crash survivors. A pilot forced to eject after a loss of power in the Arctic might have just a few hours to live. For this reason, if Canada were to acquire the F-35, it would have to invest billions of dollars to improve search and rescue — or accept the inevitable loss of pilots to the elements, even after a safe ejection from their plane.

Much the same can be said about the search-and-rescue situation off Canada's East and West coasts. When Burton Winters, an Inuit boy, became lost on sea-ice off Labrador during a blizzard in January 2012, all three search-and rescue planes in Atlantic Canada were — for mechanical reasons — unable to deploy to search for him.[83] The 14-year-old died from hypothermia before a search-and-rescue helicopter was finally sent, more than 50 hours after he went missing.

Canada's current fleets of search-and-rescue planes — the CC-115 Buffalos on the West Coast and the CC-130 Hercules operated in Central, Eastern and Arctic Canada — are due to retire in 2015 and 2017, respectively.[84] Efforts to replace the fleets began in 2002 when the Chrétien government publicly committed to procuring new aircraft.[85] In 2008, as part of its Canada First Defence Strategy, the Harper government announced its intention to replace the aircraft.[86] However, no manufacturer has been chosen, and no contract signed.

The author of this report has elsewhere argued in favour of strengthening Canada's search-and-rescue capabilities, regardless of the model of aircraft selected to replace the CF-18.[87] With the search-and rescue system in its current, near-broken state, a decision to purchase a single-engine fighter would almost inevitably result in the needless loss of Canadian pilots.

11. Conclusion

The single-engine versus twin-engine issue has not been resolved by improvements in the reliability of jet engines. Engine failures will still occur, and when they do so away from an airport, a second engine is the only thing that can prevent a crash. The issue is especially important for Canada, which has the longest coastline in the world and vast Arctic territories. As one former CF-18 pilot told FrontLine Defence in May 2011: "A single engine is stupid. There's no backup. If it fails, you're dead."[88]

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