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Search and Replace

The Case for a Made-in-Canada Fixed-Wing Search and Rescue Fleet

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ACRONYMS

ASD Alternative Service Delivery
CBR California Bearing Ratio
CFDS Canada First Defence Strategy
CRS Chief Review Services
DND Department of National Defence
EO/IR Electric Optical/Infrared
FWSAR Fixed-Wing Search and Rescue
HUD Heads-Up Display
IRB Industrial Regional Benefit
MCR Mission Capable Rate
nm nautical miles
NRC National Research Council
NVIS Night Vision Imaging System
SOR Statement of Operational Requirements
SAR Search and Rescue
SAR-Tech Search and Rescue Technician
SRR Search and Rescue Region
STOL Short Take-Off and Landing
TAWS Terrain Avoidance and Warning Systems
VTOL Vertical Take-off and Landing
USAF United States Air Force

Introduction

SEARCH AND RESCUE (SAR) is a service of national importance that requires reliable modern equipment. Yet the current fleets of Fixed-Wing Search and Rescue (FWSAR) aircraft — the CC-115 Buffalos operated on the West Coast and the CC-130 Hercules operated in Central, Eastern and Arctic Canada — are due to be retired by 2015 and 2017 respectively.[1]

The age of these aircraft already puts Canadian lives at risk due to the maintenance problems that arise after 45 years of service. The CBC's *Fifth Estate* has reported that, when an Inuit boy named Burton Winters became lost in a blizzard on the sea-ice off Labrador in January 2012, all three FWSAR planes in Atlantic Canada were — for mechanical reasons — unable to deploy to search for him.[2] The 14-year-old died from hypothermia before a search and rescue helicopter was finally sent, more than 50 hours after he went missing.

Efforts to replace Canada's FWSAR fleets began in 2002 when the Chrétien government publicly committed to procuring new aircraft.[3] In 2006, as part of its Canada First Defence Strategy (CFDS), the Harper government announced its intention to replace the FWSAR fleets.[4] In January 2012, Department of National Defence (DND) spokeswoman Tracy Poirier told David Pugliese of the *Ottawa Citizen* that the department intended to have the replacement aircraft in place by 2015:

> The $1.55-billion FWSAR project will acquire a new off-the-shelf fleet of fixed wing aircraft to replace the existing fleet of six CC115 Buffalo and ten CC130 Hercules SAR aircraft by 2015.[5]

Yet on March 9, 2012, Murray Brewster of the Canadian Press reported that the procurement had been delayed until 2017 at the earliest.[6]

Then, on May 28, 2012, Michael Den Tandt of Postmedia News reported that Treasury Board had "granted first-phase approval of a budget of $3.8-billion, with $1.9-billion of that going to so-called 'in-service support' or maintenance."[7] A new schedule has been set that "will see a draft request for proposal issued in September, with final selection of the winning bidder or bidders expected in 2014."[8]

The delays and difficulties experienced by the FWSAR procurement so far have been compounded by the fact that the original Statement of Operational Requirements (SOR) — i.e., the performance specifications set by DND that all contender aircraft must meet — has never been made public. This lack of transparency limits media scrutiny, public debate, and the testing of the government's analysis and accounting.

History of FWSAR Issue

History of Existing FWSAR Fleet

Canada operates two sets of FWSAR aircraft, the CC-115 Buffalo and the CC-130 Hercules, henceforth the "Buffalo" and the "Hercules." The Canadian-made Buffalos were acquired in 1967 as a transport aircraft and went into search and rescue service in 1973.[9] They are based in Comox, British Columbia, where their ability to fly very "low and slow" is particularly well suited to rough coastlines and mountainous terrain.

The U.S.-made Hercules used for FWSAR operations were acquired between 1964 and 1967.[10] They are based in Trenton, Ontario, and Greenwood, Nova Scotia, where they serve a region that stretches from Alberta to Newfoundland to the North Pole.

Mechanical problems associated with the age of the aircraft are reducing their Mission Capable Rates (MCR). Several Buffalos have been decommissioned and stripped for replacement parts and, in 2008, the Air Force considered buying Brazil's retired fleet of Buffalos for the same purpose.[11] In 2005, then Chief of the Defence Staff Rick Hillier stated that the "Hercules fleet right now is rapidly going downhill. We know that three years and a little bit more than that, the fleet starts to become almost completely inoperational [sic] and we will have to stop supporting operations — or else, not be able to start them."[12] Indeed, the Hercules aircraft used for FWSAR in Canada have "logged more flying hours in total than any other military Hercules fleet in the world."[13]

History of the Replacement Process

The replacement process for Canada's FWSAR fleets began in 2002 when Jean Chrétien was Prime Minister. In 2004, the federal budget stated that:

> [A] major priority for Canada's military is the purchase of modern Fixed-Wing Search and Rescue [FWSAR] aircraft…to replace older Hercules aircraft and Canada's fleet of Buffalo aircraft. Under [DND's] current plan, deliveries of the new aircraft will begin much later in the decade. This budget sets aside non-budgetary resources to allow [DND] to move this acquisition forward in time without displacing other planned capital investments.[14]

As the budget went on to explain, the allocation of new money would "accelerate the process so that deliveries can begin within 12 to 18 months."[15] The deliveries, however, did not occur, and in 2006 the new Harper government dissolved the FWSAR project office in favour of other "priority" projects.[16]

In 2008, the Canada First Defence Strategy (CFDS) committed the Harper government to procuring new vehicles for all of the services, including fighter jets for the Air Force, tanks for the Army, and ships for the Navy. The CFDS also gave a brief mention to search and rescue, expressing the government's intent to replace the FWSAR fleet.[17]

In 2009, DND stated that the FWSAR project office would be re-established once government approval was received.[18]

Also in 2009, DND proposed to sole-source the Italian-made C-27J Spartan for the FWSAR replacement. Built by Alenia, the Spartan is essentially a Lockheed Martin plane that was at the time being purchased by the U.S. Air Force as a tactical lift aircraft.

However, Industry Canada rejected DND's sole-sourcing proposal on the basis that the SOR had been narrowly drawn so as to eliminate all but one aircraft from consideration.[19] According to the CBC, another possible candidate aircraft, the Spanish-made EADS C-295, was excluded from the competition because its cabin was just 15 centimetres shorter and its cruising speed just 12 knots slower than the SOR required.[20] It can be speculated that DND was seeking to obtain tactical lift aircraft that were fully interoperable with (indeed, identical to) the U.S. Spartan fleet, and saw the FWSAR procurement as an opportunity to do this.

If so, it was a misguided effort, since the United States is now taking steps to shut down its Spartan fleet.[21] According to the U.S. Air Force: "Divesting the entire C-27J fleet…achieves savings by substituting the lower life cycle costs of the more capable C-130 for the niche C-27J capability."[22]

Moreover, DND's sole-sourcing proposal would likely have been very expensive for Canada: Australia, which pressed ahead with its own plan to purchase Spartans, paid A$1.4 billion (almost exactly c$1.4 billion) for just ten planes.[23]

After the sole sourcing of the Italian-made Spartan was rejected, the Harper government asked the National Research Council (NRC) to review DND's Statement of Operational Requirements for FWSAR — a document that has never been made public.

The NRC was especially critical of DND's refusal to consider a multi-fleet option, i.e., the acquisition of two or more types of planes to provide search and rescue across Canada.[24] The NRC ultimately recommended that the Statement of Operational Requirements be re-written in light of its report.[25]

In response to the NRC report, DND has opened up competitive bidding for the FWSAR replacement and says that it is now considering a multi-fleet option. Associate Minister of National Defence Julian Fantino, who oversees DND procurement efforts, has indicated that the government is "looking at all options."[26] The competitive process reportedly includes bids from Lockheed Martin (Hercules), Bombardier (Q400), Viking (Buffalo and Twin Otter), Alenia (Spartan), EADS (C-295), and Bell-Boeing (V-22 Osprey, a vertical-lift aircraft designed and built for the U.S. Marines).[27]

On May 27, 2010, shortly after the NRC report was released, Minister of National Defence Peter MacKay indicated that the wait for FWSAR replacements would soon be over. He told the House of Commons: "We now have the path forward. We have the information required and we are going to proceed in a way that will see us purchase new fixed wing aircraft in the very near future."[28]

But on March 9, 2012, Murray Brewster of the Canadian Press reported that the procurement had been delayed until 2017 at the earliest.[29]

Then, on May 28, 2012, Michael Den Tandt of Postmedia News reported that Treasury Board had "granted first-phase approval of a budget of $3.8-billion, with $1.9-billion of that going to so-called 'in-service support' or maintenance."[30] A new schedule "will see a draft request for proposal issued in September, with final selection of the winning bidder or bidders expected in 2014."[31]

It now seems likely that a new SOR will be drafted this summer and presented to industry in September. For this reason, it is important that media attention and public debate begin now — in order to ensure that the requirements do not exclude planes that are proven, affordable and quickly available.

Parallels to Other Problem Procurements

The problems with the FWSAR procurement have parallels in other recent and planned acquisitions of military aircraft. In October 2010, then Auditor General Sheila Fraser reported that crucial information concerning the escalating costs for new Chinook and Cyclone helicopters was withheld from ministers.[32] The acquisition cost of the Chinooks more than doubled and deliveries were delayed by five years.[33] The acquisition cost of the Cyclones increased by $2.9 billion and deliveries were delayed by seven years.[34]

At the same time, the Auditor General drew a parallel between the helicopter procurements and the planned replacement of Canada's CF-18 jetfighter aircraft with Lockheed Martin F-35 stealth fighter jets. Specifically, she expressed the hope that "no one is assessing them [the proposed F-35s] as low risk."[35] Two years later, Fraser's successor, Auditor General Michael Ferguson, reported that the DND had underestimated the full life-cycle costs of the F-35.[36]

In April 2012, Parliamentary Budget Officer Kevin Page confirmed that the procurement cost of the F-35s would be much higher than publicly stated. Specifically, he said that DND had kept "two sets of books" concerning the overall costs and were aware of — and concealed — the significantly higher numbers.[37] His office estimated the costs to be $29.3 billion, as compared to DND's estimate of $17.6 billion.[38]

As with the FWSAR procurement, the Statement of Operational Requirements for the CF-18 replacement has never been publicly released, though it has become clear that the document was drafted to exclude all but one type of aircraft. When asked by Public Works and Government Services Canada to justify the sole sourcing of CF-18 replacements, DND sent a one-page letter that simply asserted the need for a "fifth generation" fighter, and that the F-35 was the only such aircraft available.[39] The letter provided no indication as to what the term "fifth generation" actually meant.[40]

Canada's Actual FWSAR Needs

AS THE SECOND-LARGEST country on earth, Canada has a number of quite different geographical and climatic zones, from the rain forest of the West Coast to the tundra of the Arctic. It has a relatively low population density, with most of the population concentrated in cities in southern Canada. Yet the more remote regions are hardly uninhabited: they host thousands of First Nations and Inuit communities as well as major economic activities such as resource exploitation and tourism. Canada also has the longest coastline of any country in the world, with major fisheries on the East and West coasts and offshore oil-and-gas developments in the East and North. All of these factors combine to make search and rescue (SAR) a particularly important and challenging mission for Canada; a mission for which reliable modern equipment is essential.

West Coast: Low and Slow

Most FWSAR operations in British Columbia and the Yukon take place along rough and heavily forested coastlines or in mountainous terrain. In such areas, the ability to fly "low and slow" is essential for an effective search, which is why the Buffalo is used exclusively on the West Coast. Able to fly as slow as 70 knots (80 mph) with great manoeuvrability and plenty of excess

lift and power, it has proven to be a highly effective aircraft for that particular FWSAR mission. By comparison, the Hercules used in the rest of Canada has a minimum speed of 100 knots (115 mph) and is significantly less manoeuvrable, particularly in terms of its turning circle.

Thanks to the NRC report, we know that the Department of National Defence stipulated in the first SOR that the replacement aircraft should have a minimal range of 1,699 nautical miles (nm). DND stated that the minimum range FWSAR requirement for a maritime scenario on the West Coast is 1,378 nm (797 nm from Comox to the western boundary of the search and rescue region, an hour of search, plus a return flight of 581 nm to Sandspit).[41] This particular requirement effectively excluded the Buffalo—which currently serves that region—because of its range of 1,209 nm. That said, new generation Buffalos would likely be lighter (because of the use of composites in the airframe) and have more efficient engines, and thus greater range.

Flying "low and slow" makes aircraft more susceptible to dangerous weather phenomena such as rotor clouds in mountainous terrain. For this reason, DND was right to insist that any FWSAR replacement should possess "a high power to weight ratio, excellent cockpit field of view, Heads-Up Displays (HUD), Terrain Avoidance and Warning Systems (TAWS), and automated flight control systems."[42]

Central, Eastern and Arctic Canada: Range and Speed

FWSAR needs in the rest of Canada are usually different from those on the West Coast because of greater distances and the relative lack of mountainous terrain. Aircraft operating out of Trenton or Greenwood must be able to reach the High Arctic or to conduct long missions over the North Atlantic. This means that the FWSAR requirements for the Trenton and Greenwood search and rescue regions (SRRS) include both the speed and range to reach distant incidents or search patterns. The CC-130 Hercules in current use have a cruise speed of 300 knots and a range of more than 3,500 nm.[43]

These different needs point in the direction of a multi-type fleet with a slower aircraft for the West Coast and a faster and longer-range aircraft for Central, Eastern and Arctic Canada.

Short, Rough, Icy and Soft Runways

For good reason, the NRC report recommended that FWSAR replacement aircraft be able to operate on "short gravel runways and austere airfields; fly in icing conditions; operate in ground icing conditions where facilities exist."[44] With the second-largest territory and just 330 airports with paved runways, Canada has one of the lowest ratios of improved runways per area of land mass of any developed country.[45] Canada is also a country of weather extremes with runways that can be icy in the winter and soft during the spring melt and in areas with heavy rains. This means that an ability to land on less-than-optimal runways (i.e., short, rough, icy and soft) should be required for any FWSAR aircraft, for safety reasons and because search and rescue missions will sometimes demand this ability, e.g. to pick up accident victims from mine sites, forestry camps or remote communities.

STOL

The current Buffalo fleet has an exceptional Short Take-Off and Landing (STOL) capability, requiring just 369 metres for take-off and 299 metres for landing.[46] The U.S.-made Hercules requires 1,003 metres for take-off and 427 metres for landing.[47]

The Italian-made Spartan also has excellent STOL capability with 580 metres required for take-off and 340 metres for landing.[48] The Spanish-made EADS C-295 requires a much longer 844 metres for take-off and 680 metres for landing, rendering it a problematic option for Canada.[49]

Viking's new Twin Otters have a take-off distance of just 366 metres and a landing distance of 320 metres — about the same as a Buffalo.[50] Bombardier Q400s can land and take off from runways of less than 500 metres.

Rough and Icy Runways

The Buffalo can land on unprepared terrain where the Italian-made Spartan, in particular, cannot.[51] One reason for this is the difference in landing weights: the Buffalo has a landing weight of 17,772 kg while the Spartan has a landing weight of 30,500 kg.[52] A heavier landing weight also means that the runway has to be stronger, i.e., having a higher California Bearing Ratio as discussed below.

Like most de Havilland aircraft, the Buffalo and Twin Otter have proven histories of operating under austere conditions in the very same remote

and difficult areas where many of Canada's SAR incidents occur. Twin Otters, in addition to being able to land on rough runways, can — depending on the season and needs — even be equipped with "tundra" tires, floats or skis.

As a result of the NRC report, DND now stipulates: "Aircraft must be capable of operation from semi-prepared (including gravel) runways, taxiways and aerodromes."[53] DND also accepts that the aircraft must be able to operate in extreme arctic conditions.[54]

Soft Runways

FWSAR aircraft should be able to land and take off from softer terrain, including soft runways and ideally even sports fields. The California Bearing Ratio (CBR) is one measurement of how firm the terrain must be before a particular aircraft type can land safely, with higher numbers indicating greater firmness. The Twin Otter has a CBR at the very bottom of the scale, while the Buffalo, Q400, C-295 and the C-130J Hercules have CBRs of 2 or less.[55] The Spartan, significantly and problematically, has a relatively high CBR of 4, and is not even capable of landing on some softer asphalt runways.[56]

Imaging Equipment

The NRC report spent some time discussing bubble windows and ergonomic seating for spotters on FWSAR planes. According to the NRC, the original SOR stipulated a need for bubble windows that are capable of withstanding cabin pressure at high altitudes.[57] But as the NRC observed, conducting searches from high altitudes is rare and, if such a search were required from an unpressurized aircraft, the crew would simply have to don oxygen masks.[58]

The NRC reported that the incorporation of high capability imaging technology into FWSAR aircraft has become standard practice internationally.[59] This technology includes night-vision imaging systems (NVIS) and infrared (i.e., heat identifying) imaging systems.

According to the NRC report, the original SOR stated that SAR-Techs must wear helmets with night vision goggles during night operations and therefore require additional clearance within the planes. However, the NRC found that the SAR-Techs currently operating in Buffalos do not wear helmets with night vision goggles and that some do not even have helmets on which such goggles can be worn.[60]

The issue of night vision goggles becomes less important if the aircraft itself has the latest imaging equipment, since this removes the onus from the SAR-Techs to engage in visual scanning of the ground or water. Another consequence is that some traditional requirements such as field of vision are no longer essential for effective FWSAR. By incorporating such requirements into the original SOR, DND may have excluded aircraft that are well suited for twenty-first century search and rescue missions. The inclusion of advanced sensors such as Electronic Optical and Infrared (EO/IR) was recommended by the NRC report. It was also mentioned as a mandatory requirement for FWSAR by a 2011 DND report on "Essential Elements of the Fixed Wing Search and Rescue (FWSAR) Capability."[61]

Cargo Capacity Needed for SAR

According to a DND report, the original SOR stipulated that the FWSAR replacement should be able to carry a crew of six and a payload of at least 1,531 kg.[62] But according to the NRC, that payload is not currently carried "by either the CC-130 Hercules or the CC-115 Buffalo, and indeed cannot be carried by the CC-115 Buffalo."[63]

The SOR also stipulated that the FWSAR replacement must be able to carry standardized 88 x 108-inch NATO cargo pallets. The NRC pointed out that transport is not the primary duty of the FWSAR fleet and that the reason for this requirement was unclear.[64] The NRC speculated that it was included as an easy way of ensuring that SAR-Techs would have room to manoeuvre and deploy their bulky and heavy equipment.[65]

One could also speculate that the requirement concerning NATO pallets was included for disaster relief operations. In January 2010, FWSAR aircraft stationed at Greenwood provided airlift assistance for earthquake victims in Haiti.[66] But as important as this contribution was, disaster relief is still a secondary role for FWSAR aircraft and the Royal Canadian Air Force is well equipped with transport planes, including four new U.S.-made C-17 Globemaster strategic lift aircraft and 17 new U.S.-made C-130J Hercules tactical lift aircraft.[67]

More likely, DND was looking to acquire a smaller tactical lift aircraft able to operate on runways, such as those at forward operating bases in Afghanistan, which are too short for C-17s and C-130Js.[68] But if the ability to engage in disaster relief or military transport was considered relevant to the FWSAR procurement, this should have been said explicitly and carefully justified.

Costs and Uncertainties

In a May 2009 internal audit of the FWSAR procurement, the Chief of Review Services at DND said the objective was not only to meet the current level of service for search and rescue but also to reduce the associated costs of maintaining the FWSAR fleet.[69] He was right that, in a time of constrained budgets, the relative cost of different options should be an important consideration. Moreover, any assessment of relative costs should include the original procurement cost as well as the servicing of the equipment and other associated legacy expenses. A slightly less capable but still adequate plane that costs significantly less than the other options might well be an acceptable choice for FWSAR.

Cost and performance uncertainties must also be considered. Already capable and proven aircraft should be favoured over ones that require substantial changes for search and rescue or involve new and unproven technologies — and therefore uncertain mission capable rates and maintenance and repair expenses.

For these reasons, the Bell-Boeing V-22 Osprey should not be considered a serious contender for Canadian SAR. The Osprey is the only aircraft in production that can convert itself in flight from a turboprop plane to a helicopter. Designed for the U.S. Marines, the tilt-rotor aircraft has experienced many design flaws and setbacks.[70] The Osprey is also more expensive than the other options and its complex mechanics would almost certainly result in a lower mission capable rate and higher maintenance and repair costs through its operational lifetime.

Ramp

We know from the NRC report that the original SOR called for a ramp at the rear of the aircraft that is "capable of accommodating rapid loading/off-loading" of NATO standard pallets "as well as serving as the primary exit for airdrop of SAR personnel and equipment."[71] However, the SOR also called for an "alternate para door" certified for "safe parachute delivery of personnel (using the CSAR-7 parachute) and equipment…without undue risk from airflow to personnel, equipment and aircraft."[72] The NRC agreed with the requirement of a ramp, mostly for reasons concerning the loss of situational awareness and injuries that can result when parachutists deploy incorrectly from side-doors.[73]

There are other ways to reduce these risks. The NRC recognised that deflectors could be installed to create a more favourable airflow for jumping.[74] Bombardier Q400s used for search and rescue in other countries have "drop hatches" installed on their underbellies to allow for the accurate and safe deployment of life rafts and other SAR equipment. Using aircraft with a slower minimum speed also reduces airflow and therefore risk. Another consideration is the relative ability of different types of aircraft to land on short and unimproved runways or even on water, which can reduce the frequency of parachuting required.

It is noteworthy that the original SOR began its analysis of the need for a ramp by referring to the loading and unloading of cargo. This ability would of course be essential for a tactical lift cargo aircraft or an aircraft procured for a combination of cargo and SAR duties. But DND has not expressed the need for a multi-purpose aircraft nor has it made the case for one. It also has two fleets of highly capable cargo aircraft already, in the form of the new C-17 Globemasters and C-130J Hercules.[75] For these reasons, the cargo-handling ability provided by a ramp should be discounted — and other options for deploying SAR-Techs and their equipment more deeply explored.

Open, Competitive, Tendered Process

Open, competitive, tendered processes are widely recognized as providing greater certainty of fit between equipment and actual needs as well as the best value for taxpayers. Another consideration is the need to ensure jobs and economic development in Canada. When procuring equipment from foreign companies, Industrial Regional Benefits (IRBs) are negotiated to ensure investments in Canada, including contracts for manufacturing, assembly and maintenance. However, the federal government's ability and willingness to engage in long-term monitoring and enforcement of IRBs can be questioned, and therefore their eventual delivery. IRBs are not required when purchasing equipment that is already made in Canada or would in any event be made in Canada — as would be the case with new Buffalos, Twin Otters or Q400s.

Made-in-Canada Options

THE CANADIAN AEROSPACE industry has a long record of producing highly capable and reliable fixed-wing utility aircraft. Beginning in the 1940s, de Havilland Canada developed and produced the Beaver, Otter, Twin Otter, Caribou, Buffalo, Dash 7 and Dash 8 line of aircraft. All of these aircraft types—including many of the original Beavers and Otters—are still in operation worldwide, and renowned for their ability to handle austere "bush flying" conditions.

The de Havilland legacy lives on at two Canadian owned-and-operated aircraft manufacturers. Montreal-based Bombardier produces the Q400s operated by Porter, Air Canada and soon WestJet. Victoria-based Viking Air produces new Twin Otters and also owns the rights for the Buffalo.

Buffalo

Built in 1967 and originally used as cargo aircraft, the Buffalo had been used for FWSAR since 1975.[76] The Buffalo fleet only operates in British Columbia and the Yukon.

The Buffalo is exceptionally well suited for Canada's West Coast. Its runway requirements are so low that it can land and take off from sports fields. It has a minimum speed of just 70 knots, with lots of reserve power, lift, and manoeuvrability.

CC-115 Buffalo

One low-cost temporary option for FWSAR on the West Coast is to replace the engines of the current Buffalo fleet. A briefing note prepared for Defence Minister Peter MacKay in September 2012 reportedly said: "The Buffalo airframe is remarkably sturdy, however, the aircraft faces severe obsolescence issues in supporting its engines in particular.... Re-engine of the C-115 should definitely be considered."[77] But when asked about the matter one year later, DND spokesperson Kim Tulipan replied: "While ensuring the day-to-day support of the existing Buffalo engine, the Canadian Forces have made no decision to pursue engine replacement in our existing Buffalo fleet."[78]

If such a decision were taken, Viking Air would be able to stagger the engine replacements by working on one aircraft at a time, thus enabling FWSAR coverage to continue with the other aircraft. The Pratt & Whitney 100 series turboprop engines made in Lethbridge, Alberta, and used on the Spanish-made EADS C-295 as well as the Canadian-made Q400, offer a "near perfect match" for this purpose.[79]

Viking Air has also placed a competitive bid for a longer-term FWSAR replacement with the DHC-5NG, a new generation Buffalo that would also be equipped with Canadian-made Pratt & Whitney engines.[80] Viking believes it

can improve upon the nearly 50-year old design by incorporating new technologies and building methods, as it has already done with the Twin Otter — for which it now has more than 80 orders worldwide. Viking has also looked into pressurizing the cabin, which would increase the cruise altitude and utilize the performance of the engines more efficiently and to their full capability, thus increasing the aircraft's range.[81] At the same time, Viking says the research and development costs for new generation Buffalos would be relatively low, because the aircraft is proven and has many aspects that cannot be improved upon.[82]

Although new or refurbished Buffalos would be very suitable for British Columbia and the Yukon, they would not be appropriate for elsewhere in Canada because of variations in geography and the different mission characteristics of those regions. In other words, choosing to stick with Buffalos would necessitate a mixed-fleet — which, of course, is exactly what Canada has currently.

DND has expressed concerns about the dimensions of the Buffalo's cabin, which it believes limits the performance of SAR-Techs and poses health and safety issues for them. However, the NRC reports that the internal dimensions of the Buffalo exceed those of the CH-149 Cormorant helicopter in which most of the same heavy SAR equipment is used.[83] The NRC analysts went so far as to interview a number of SAR-Techs who work on the Buffalos, none of who had any complaints about the space or clearance within the planes.[84] In response to the NRC report, DND stated that it is "conducting further human factors research on SAR technician in-flight tasks."[85]

Twin Otter

First built in 1965, the Twin Otter is one of the most successful Canadian designed-and-produced aircraft with more than 800 in civilian and military service worldwide.[86] The Royal Canadian Air Force currently operates a fleet of four older Twin Otters in the Arctic for SAR operations and airlifting supplies.[87] The 2005 Federal Budget indicated that these aging utility aircraft would be replaced.[88] The difficulty was that no direct replacement was available at the time, and so the Twin Otters were "re-winged" in order to keep them flying until 2017.[89]

Rugged and versatile, the Twin Otter has a STOL capability of just 366 metres as well as excellent lift and manoeuvrability.[90] These characteris-

Twin Otter *(Photo Taken By Ansgar Walk)*

tics are well suited for the "low and slow" missions that typify West Coast SAR operations. Moreover, the fact that Twin Otters can be fitted with amphibious floats offers the possibility of reduced reliance on helicopter backup, since the planes themselves can land on water (albeit not at night or in storm conditions) to bring accident victims on board.

On the West Coast, the majority of incidents requiring FWSAR occur on the water. For this reason, Canada has used seaplanes in the past, notably the PBY-5A Canso which was made in Canada under license and used for FWSAR from the end of the Second World War until 1961. The Grumman Albatross flying boat was then used until the Buffalos were redeployed into SAR service in the 1970s.[91] Other countries still use seaplanes for SAR, including Malaysia, which has SAR-configured Canadian-made Bombardier 415 water-bombers.[92]

Viking Air produces a SAR version of its new Twin Otter called the Guardian, which is available with the latest in SAR imaging equipment, including EO/IR.[93] The standard range of the Viking Twin Otter is 799 nautical miles, but this can be extended to 980 nm with long-range wingtip tanks and to 1,380 nm with an additional internal patrol tank.[94] The latter range is sufficient to cover almost all FWSAR needs, with the NRC reporting that 95 per-

cent of incidents occur within 800 nautical miles of the main FWSAR operating bases.[95]

The Canadian-made Viking Twin Otter is a low-cost aircraft, with the standard version selling for around $6.8 million and the fully-equipped long-range SAR version selling for around $15–17 million, including a state-of-the-art imaging system.[96] This compares to approximately $53 million for an Italian-made Spartan, $60 million for a U.S.-made Hercules, and $69 million for a U.S.-made Osprey.[97]

The Twin Otter's limitations include a relatively low cruising speed (182 knots), relatively small internal dimensions (passenger versions are equipped with 19 seats and lack full head-clearance), and the absence of a ramp (as discussed above).

Q400

Another Canadian-made candidate for FWSAR is Bombardier's Q400, also known as the Dash 8-400. According to Bombardier, the speed and cabin size of the aircraft fit DND's requirements for the FWSAR program.[98]

Bombardier already makes a variant of the Q400 for maritime patrol and has sold the previous variant, the Q300, to the Swedish and Japanese Coast Guards and to the Mexican Navy.[99]

According to the NRC, the original SOR stipulated a minimum cruise speed of 272 knots.[100] The cruise speed of the current fleet of Hercules is slightly faster than the SOR at 292 knots. By comparison, the Q400 has a relatively high cruise speed of 367 knots, which means that it could provide on-site assistance much faster that Canada's current capabilities.

As for range, the off-the-shelf version of the Q400 has a range of 1,360 nautical miles, which could easily be extended with long-range fuel tanks so as to exceed the original SOR's requirement of 1,699 nm.[101] The Q400 can operate on soft pavement and gravel runways with a STOL capability of less than 500 metres, which is significantly better than the U.S.-made Hercules.

The Q400 can also fly relatively "low and slow" and has generous internal dimensions. It does not have a ramp but — as discussed above — this may not actually be an essential requirement. Q400s used for search and rescue in other countries have "drop hatches" that allow for the accurate and safe deployment of SAR equipment. The Q400 is also relatively inexpensive: around $30 million.[102]

Bombardier Q400

Alternative Service Delivery

THERE HAS BEEN some speculation that DND might be considering an "alternative service delivery" (ASD) contract whereby FWSAR would be provided by a private company. In 2011, the House of Commons Finance Committee was briefed on this option by Discovery Air Innovations of Montreal.[103] One also sees indications of this thinking in the invitation for "Letters of Interest" issued by Public Works and Government Services Canada on March 9, 2012,[104] which Murray Brewster of the Canadian Press reported on as follows:

> The specifications would require the winning bidder to provide a single aircraft to be on standby in each sector 24 hours a day, seven days a week. The parameters are so broad they even leave it up to the companies to suggest where the planes should be based.
>
> Taken together the requirements have led to speculation the federal government is prepared to farm out fixed-wing search-and-rescue, possibly as an alternative service delivery contract.[105]

However, Public Works and Government Services Canada's FWSAR website includes a "Frequently Asked Questions" page where the response to the third question includes the following statement: "[A] complete Alternative Service Delivery Solution does not form part of the procurement strategy chosen."[106] Given this statement, and in the absence of any clear indi-

cation that DND is considering the ASD option, this report has assumed that FWSAR will continue to be conducted by Canadian Forces owned-and-operated aircraft.

Recommendations

THIS REPORT HAS sought to provide an objective, rigorous, fully justified and transparent assessment of Canada's actual FWSAR needs. It concludes with the following three recommendations.

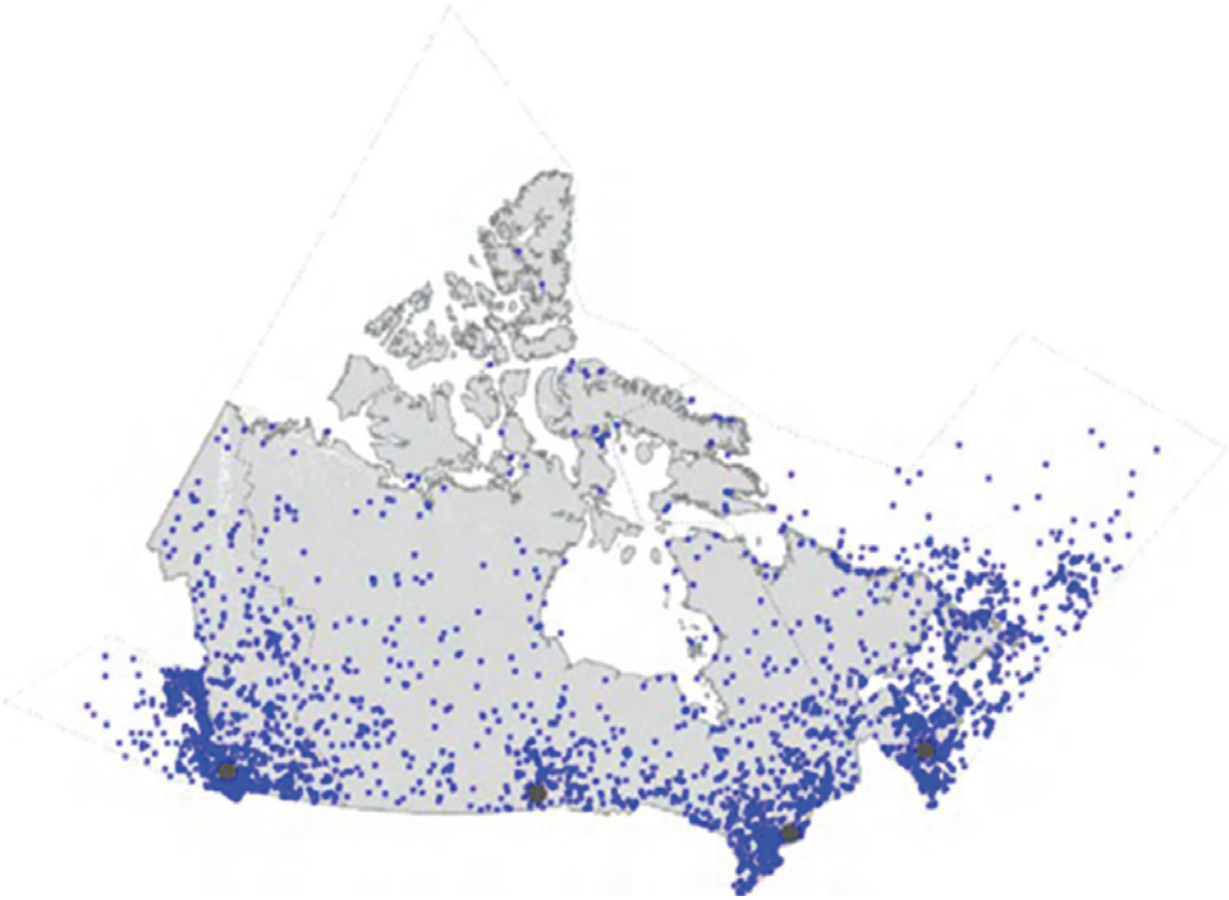
Recommendation 1: The Canadian government should clearly articulate a Statement of Operational Requirements (SOR) for Fixed-Wing Search and Rescue aircraft that recognizes the different requirements on Canada's West Coast and the necessity of a mixed fleet.

Recommendation 2: The Canadian government should ensure the SOR does not preclude consideration of made-in-Canada aircraft.

Recommendation 3: The Canadian government should conduct a transparent competition that will provide the Canadian Forces with effective FWSAR aircraft at the best value to Canadians in terms of cost, performance, and jobs.

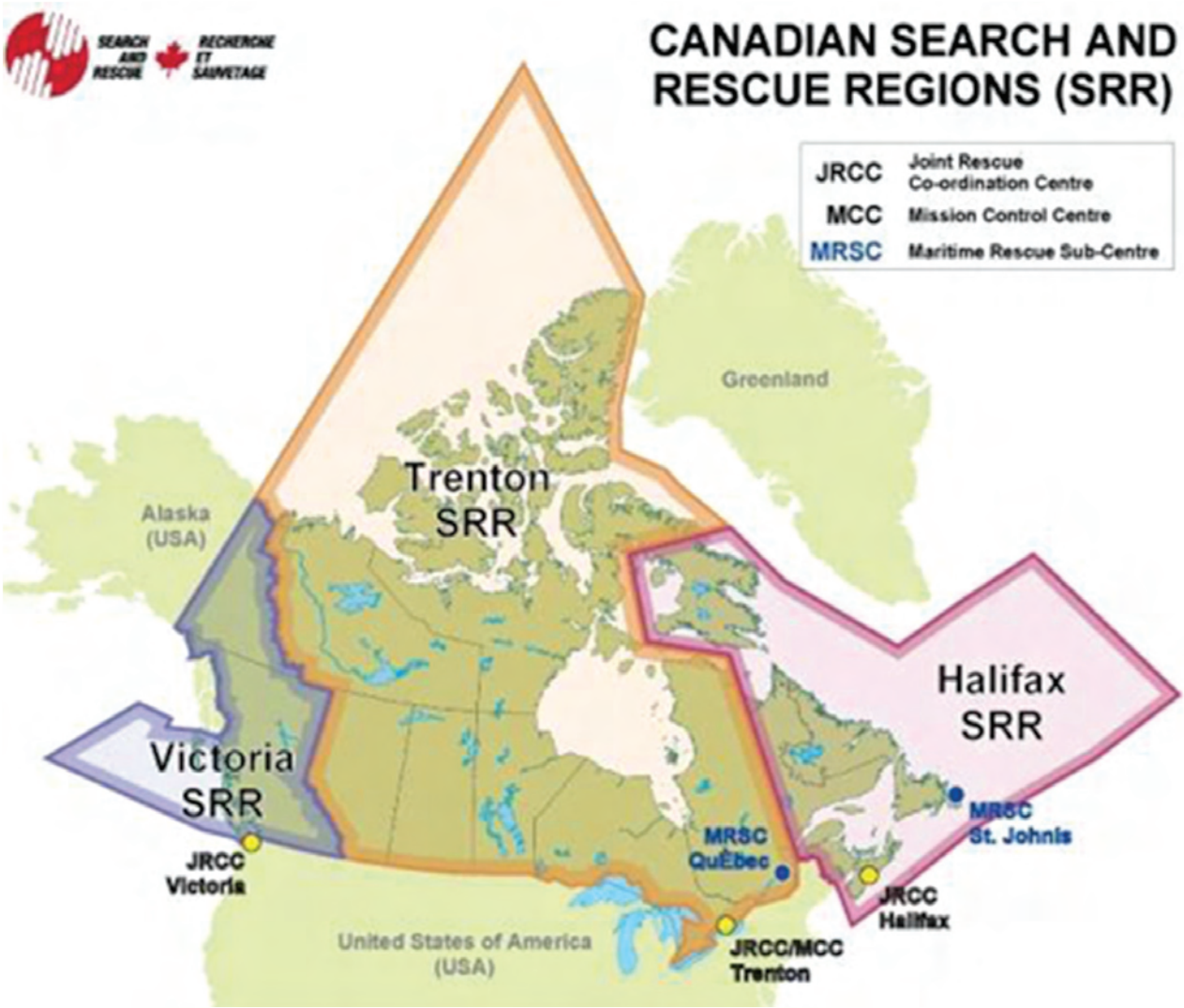
Appendix 1

Historical Distribution of FWSAR Incidents[107]



Appendix 2

Geographical Responsibilities of Canadian SRR



Appendix 3

Technical Specifications

FIGURE 1 Thumbnail of Technical Specifications of the CC-115 Buffalo and the Bids for Replacement

	Alenia C-27J Spartan (Italy)	Boeing V-22 Osprey (United States)	Bombardier Q400 Series (Canada)	EADS C-295 (Spain)
Maximum Speed (knots)	315	275	367	260
Cruise Speed (knots)	314	260	360	260
Range (nm)	3,200	722	1,360	3,040
Ceiling (m)	9,144	7,620	7,620	9,144
Payload Capacity (kgs)	11,500	3,772.7	n/a	20,400
Take Off Distance (m)	580	N/A (VTOL)	<500	844
Landing Distance (m)	340	N/A (VTOL)	<500	680
CBR	4	N/A (VTOL)	<2	2
Est. Cost per unit ($million)	53.3	69.3	30	22

	Lockheed Martin C-130J (United States)	Viking CC-115 Buffalo (Canada)	Viking DHC-5NG Buffalo (Canada)	Viking Twin Otter Guardian (Canada)
Maximum Speed (knots)	362	235	300+	182
Cruise Speed (knots)	250	180	180+	170
Range (nm)	3,700	1,209.5	1,209.5+	799–1,380
Ceiling (m)	9,144	3,048	3,048+	3,048
Payload Capacity (kgs)	21,732.7	2,727	2,727+	2,522
Take Off Distance (m)	580	369	<369	366
Landing Distance (m)	340	299	<299	320
CBR	2	<2	<2	1
Est. Cost per unit ($million)	48.5	12–15 (refit)	18–20	15–17

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