THE ROYAL CANADIAN AIR FORCE JOURNAL

FALL 2013 VOL. 2 NO. 4

IN THIS ISSUE

LIFE JACKETS, EBS AND POOPY SUITS: DCIEM'S CONTRIBUTION TO SEA KING OPERATIONS

"STEWARD, WHY DOES MY PIZZA TASTE LIKE ZINC CHROMATE PRIMER?"

SEASPRITE TO SEA KING: THE ROYAL CANADIAN NAVY'S SHIP-BORNE ANTISUBMARINE HELICOPTER CAPABILITY

AND MUCH MORE!

PRODUCED BY
THE CANADIAN FORCES
AEROSPACE WARFARE CENTRE

National Defence Défense nationale
Canada

THE ROYAL CANADIAN AIR FORCE JOURNAL is an official publication of the Commander Royal Canadian Air Force (RCAF) and is published quarterly. It is a forum for discussing concepts, issues and ideas that are both crucial and central to aerospace power. The *Journal* is dedicated to disseminating the ideas and opinions of not only RCAF personnel, but also those civilians who have an interest in issues of aerospace power. Articles may cover the scope of air force doctrine, training, leadership, lessons learned and air force operations: past, present or future. Submissions on related subjects such as ethics, technology and air force history are also invited. This *Journal* is therefore dedicated to the expression of mature professional thought on the art and science of air warfare and is central to the intellectual health of the RCAF. It serves as a vehicle for the continuing education and professional development of all ranks and personnel in the RCAF as well as members from other environments, employees of government agencies and academia concerned with air force affairs.

EDITORIAL STAFF
Editor-in-Chief: Colonel Martin Cournoyer, CD
Senior Editor: Major William March, CD, MA

EDITORIAL BOARD
Colonel William Lewis (Retired), OMM, CD, M Eng, M Ed, MBA, MDS, PhD
Lieutenant-Colonel Paul Johnston, CD, MA – Canadian Forces College
Major Raymond Stouffer, CD, PhD – Royal Military College
Doctor Allan English, CD, PhD – Queen's University
Doctor James Fergusson, PhD – University of Manitoba
Doctor Stephen Harris, CD, PhD – Directorate of History and Heritage
Doctor Randall Wakelam, CD, PhD – Royal Military College

Published by Canadian Forces Aerospace Warfare Centre
ISSN 1927-7601

ASSISTANT EDITORS
Adri Boodoosingh, Lisa Moulton and Françoise Romard

GRAPHIC DESIGN
Denis Langlois and Luc Leroy

ONLINE EDITION ANIMATION
Hope Smith

http://www.rcaf-arc.forces.gc.ca/en/cf-aerospace-warfare-centre/index.page
http://trenton.mil.ca/lodger/cfawc/eLibrary/Journal/Current_Issue_e.asp

ACTING PRODUCTION MANAGER
Françoise Romard

For copies of this publication or to be placed on a distribution list contact
CFAWCProd@forces.gc.ca

NOTE TO READERS
As a bilingual journal, readers should take note that where quotations are translated from their original language, we will use the term [Translation] at the end of the quote to indicate that readers can find the original text in the other language version of the *Journal*. Unless otherwise noted, photographs appearing in the RCAF *Journal* are attributable to the public domain.

THE ROYAL CANADIAN AIR FORCE JOURNAL

SUBMISSION REQUIREMENTS

THE ROYAL CANADIAN AIR FORCE JOURNAL welcomes the submission of articles, book reviews and shorter pieces (which will be published in the Letters to the Editor, Points of Interest and Pushing the Envelope sections) that cover the scope of air force doctrine, training, leadership, lessons learned and air force operations: past, present or future. Submissions on related subjects such as ethics, technology and air force history are also invited.

JOURNAL SECTIONS

ITEM	WORD LIMIT*	DETAILS
LETTERS TO THE EDITOR	50-250	Commentary on any portion of a previous *Journal*.
ARTICLES	3000-5000	Written in academic style.
BOOK REVIEWS	500-1000	Written in academic style and must include: • the book's complete title (including sub-title); • the complete names of all authors as presented on the title page; • the book's publisher, including where and when it was published; • the book's ISBN and number of pages; and • a high resolution .jpg file (at least 300 dpi and 5 by 7 inches) of the book's cover.
POINTS OF INTEREST	250-1000	Information on any topic (including operations, exercises, and anniversaries) that is of interest to the broader aerospace audience.
PUSHING THE ENVELOPE	250-2000	Forum for commentary, opinions, and rebuttal on *Journal* articles and/or issues that are of interest to the broader aerospace audience.

* Exclusive of endnotes

AUTHORS ARE ASKED TO NOTE THE FOLLOWING GUIDELINES

- Submissions may be made in either official language.
- Authors must include a brief (one paragraph) biographical sketch which includes current appointment/position, telephone number, and email address. Please include all professional and academic designations as well as military decorations.
- Selected articles that have been peer reviewed have a to the left of the title.
- The Senior Editor will notify contributors on the status of their submission. It may not be possible to publish all submissions.
- All text submissions must be digital, in Microsoft Word or rich text format. Files must not be password protected and must not contain macros. Files may be submitted by mail or email at the addresses provided below.
- All supporting tables, images and figures that accompany the text should be sent in separate files in the original file format (i.e., not imbedded in the text). Original vector files are preferred; high resolution (not less than 300 dpi) .psd or .jpg files may be submitted.
- Authors are now required to provide "alternate text" with detailed description for all figures. The alternate text is to be labelled as such and placed below the caption.
- Copyright permissions are required for all material that is not Department of National Defence or author originated. It is the author's responsibility to obtain and submit the necessary written permissions which must include the author's/artist's name as well as the publisher's name and location. Any material not meeting these requirements may be omitted from the article.
- The Senior Editor may select images or have graphics created to accompany submissions.
- Authors should use *Oxford English* or *Petit Robert* spelling. When required, reference notes should be endnotes rather than footnotes and formatted in Chicago style. For assistance refer to *The Little, Brown Handbook, Le guide du rédacteur,* or CFAWC Production Section at CFAWCProd@forces.gc.ca
- Acronyms and abbreviations should be used sparingly:
  - If they are required in the text, the term is to be written out in full the first time it is used and then followed by the abbreviated form in brackets.
  - If they are required in tables or figures, each table and figure will contain a list of abbreviations.
  - A list of all abbreviations (and their terms) used in the text will be included at the end of each submission.
- The Senior Editor reserves the right to edit submissions for style, grammar, and length, but will not make editorial changes that will affect the integrity of the argument without consulting the author.

CALL FOR SUBMISSIONS

For the **Spring 2014** issue: **30 January 2014**
For the **Summer 2014** issue: **30 April 2014**
For the **Fall 2014** issue: **30 July 2014**
For the **Winter 2015** issue: **30 October 2014**

FOR FURTHER INFORMATION OR TO MAKE A SUBMISSION PLEASE CONTACT THE EDITOR AT:

Canadian Forces Aerospace Warfare Centre
8 Wing Trenton
Box 1000 Stn Forces
Astra, Ontario K0K 3W0
Attn: Major William March
William.March@forces.gc.ca

DISCLAIMER

Opinions expressed in the *Journal* remain those of the author and do not represent Departmental or Canadian Forces policy. Doctrine, training and other material published in the *Journal* does not represent authority for action on that particular topic. All published material remains copyright of the Department of National Defence and may not be used without written permission.

VOL. 2 | NO. 4
FALL 2013

4 EDITOR'S MESSAGE

5 LETTERS TO THE EDITOR

CF Photo: Cpl David Randell

CF Photo

CF Photo: Sgt René Dubreuil

ARTICLES

8 **LIFE JACKETS, EBS AND POOPY SUITS: DCIEM'S CONTRIBUTION TO SEA KING OPERATIONS**
By Dr. C. J. Brooks

18 **SEASPRITE TO SEA KING: THE ROYAL CANADIAN NAVY'S SHIP-BORNE ANTISUBMARINE HELICOPTER CAPABILITY**
By Lieutenant(N) Jason Delaney

44 **OPERATION BRIDGE: A BOLD LEAP TOWARDS THE CYCLONE**
By Colonel Sam Michaud, OMM, M.S.M., CD (Retired)

55 **"STEWARD, WHY DOES MY PIZZA TASTE LIKE ZINC CHROMATE PRIMER?"**
By Major Gordon Crumpler, CD (Retired)

BOOK REVIEWS

63 **A HISTORY OF THE MEDITERRANEAN AIR WAR, 1940–1945, VOLUME ONE: NORTH AFRICA, JUNE 1940 – JANUARY 1942**
Review by Major Chris Buckham, CD, MA

65 **BROKEN ARROW: AMERICA'S FIRST LOST NUCLEAR WEAPON**
Review by Dr. Sean M. Maloney

66 **CLASHES: AIR COMBAT OVER NORTH VIETNAM 1965–1972**
Review by Captain Richard Moulton

POINTS OF INTEREST

69 **INDIVIDUAL TRAINING AND EDUCATION (IT&E) MODERNIZATION FOR THE CANADIAN ARMED FORCES**
By Lieutenant-Colonel Debbie Miller, OMM, CD, MA, MDS

EDITOR'S MESSAGE

It has been a few years since I was a spry, young 50-year old. However, except for a few more aches and pains, the occasional loss of a word or wondering why I had entered a particular room, I still feel much like I did when I first put on a uniform ... sort of like the CH124 Sea King. It has been five decades since this Sikorsky helicopter first put on the "uniform" of the Royal Canadian Navy, and it is still going strong.

Just to put things into perspective, in 1963, the Conservative Government of John Diefenbaker would lose an election to Liberal Lester B. Pearson; the top movies at the box office were *Dr. Strangelove*, *The Birds* and *Tom Jones*; favourite television shows were *My Favorite* (sic) *Martian*, *McHale's Navy* and *Petticoat Junction*; 12 cents would buy you a litre of gas; a new house would set you back $20,000; 5 cents would buy you a candy bar or a comic book; and the cost of a new Sea King helicopter was approximately $6.5 million.

In 2013, the Conservatives, under Stephen Harper, are in power (although his wife was born in 1963); the top movies at the box office (so far) are *Iron Man 3*, *Despicable Me 2* and *Man of Steel*; favourite television shows are *NCIS*, *Monday Night Football* and *The Big Bang Theory*; in Ottawa, a litre of gas will cost you $1.24, a new house in Ottawa may cost you $382,248; a pocket full of nickels is required to buy either a candy bar or a comic book; and the cost of a CH148 Cyclone helicopter is ... still being debated.

What is not up for debate is the ongoing requirement for a combat-capable, multi-mission maritime helicopter. In 1963, they were a necessary part of the defence "toolbox" to deal with issues such as the assassination of a president, the cold war and Cuban Missile Crisis. Five decades of failing states, the global war on terrorism and trans-border crime will make the Sea King and the Cyclone mighty handy to have on hand.

So, in the way of a "Happy Birthday," the articles in this issue of *The Royal Canadian Air Force Journal* pay homage to the aircraft and to the men and women who designed, fixed and flew them in peace and war.

Oh, in case you were wondering, the Maple Leafs won the Stanley Cup in 1963 ... it seems like only yesterday.

Enjoy the read.

Sic Itur Ad Astra

Major William March, CD, MA
Senior Editor

LETTERS TO THE EDITOR

Dear Bill:

Featured as one of the main articles in the Spring 2013 (Vol. 2, No. 2) issue of *The Royal Canadian Air Force Journal*, I was somewhat dismayed to read a pillorying of Air Chief Marshal Sir Arthur Travers Harris' "command" of the Royal Air Force's wartime Bomber Command, in particular, and the area bombing strategy he so steadfastly professed, in general, especially in light of the recent recognition and acknowledgement of service bestowed upon the wartime veterans of that command by the governments of both the United Kingdom and Canada. In short, Major Lynne Chaloux, author of "Unshakeable Faith: The Flawed Command of Bomber Harris," uses the Ross Pigeau / Carol McCann command analysis model, very much in vogue with the Canadian Forces "to evaluate the dimensions relating to Harris' competency, authority and responsibility (CAR) and to assess the overall balance and effectiveness of Harris' command."[1]

Is the Pigeau/McCann model an effective tool for the assessment of command (the term they use in preference to leadership) capabilities? Of that there is no doubt. Ross Pigeau, PhD, is an experimental psychologist and is currently the Director General of Defence Research and Development Canada (DRDC) Toronto. Along with Carol McCann, currently Head of the Adversarial Intent Section of DRDC, both have researched military leadership and command effectiveness in depth, and when their initial work in the field was published over a decade ago, it was lauded as a pioneering study of the human factors as determinants of military success, filling a void that had existed in the consideration of those determinants to that point in time. As such, their findings were enthusiastically embraced by our military leadership of the day, and both have extensively researched decision making within the study of the human aspects of military command and control. That said, and while this is in no way meant to denigrate their excellent, ground-breaking work, both Pigeau and McCann are exclusively (albeit very talented) academic researchers, with no personal experience with respect to military leadership. Since their pioneering efforts were first published, others have added to the body of work in the field, including former senior (and decorated) operational combat arms officers who are also distinguished scholars and educators, possessed with the credibility of their own command experiences. While acknowledging the utility of the CAR model, they also opine that for all the clinical attempts to *qualify* and *quantify* successful command (leadership) traits, it is a capability that frequently defies absolutes, and there are many variables and intangibles associated with it.

Regrettably, Chaloux's assessment of Harris' leadership skills "goes off the rails" early, when she categorically pronounces that the CAR model "allows for the necessary depth of analysis into Harris' abilities, responsibilities, beliefs, actions and reactions over a specific timeframe and is, therefore, deemed most suitable to dissect pertinent aspects of this complex and controversial commander."[2] Deemed most suitable according to whom? And why? The nub of Chaloux's conviction is that Harris:

> had a singular and seemingly intractable approach to war—to obliterate Germany's war production capacity by area bombing its cities. This inflexible approach inhibited his ability to see the bigger picture with any measure of objectivity and was the Achilles heel of his leadership, limiting his command capability, resulting in an abuse of his authority and, ultimately, having a detrimental effect on the Allied offensive.[3]

Chaloux then contends that Harris' unshakeable faith in area bombing became measures of "obstinacy and dogmatism"[4] that, in her opinion, prevented him from being a great commander. In presenting her case against Harris' leadership and the area-bombing policy, she takes shots at his relationships with superiors and contemporaries, his delayed switch to selective targeting, his unwillingness to pursue the panacea targets, then his decision not to follow up on those that were targeted as well as his excessive and unnecessary killing of German civilians. Overall, she maintains that the resources dedicated to the manning and equipment of Bomber Command constituted an inappropriate and wasteful allocation of scarce resources, both human and materiel. She then concludes:

> Using Pigeau and McCann's model, Harris' high authority and medium level of responsibility, that was [sic] coupled with a chain of command that failed to keep him in check, ultimately led to a situation bordering on dangerous command or abuse of authority. … This is not reflective of the balanced command aspired to by the CAR model.
>
> *Nonetheless, this is an accurate portrayal of a talented yet flawed commander, whose considerable power exceeded his abilities to wield it most effectively.*[5] [emphasis added]

This last sentence is highlighted by my emphasis because it, at best, constitutes an unwarranted conclusion by its author. On the contrary, I found this article to be a case of treating a very complex leadership situation in an inappropriately simplistic manner, expressed from a limited knowledge base, and exacerbated by apparently blind adherence to the limited (and frequently inappropriate) constituents of the CAR model for overall leadership assessment.

I believe there are myriad definitions, opinions, components and determinants that constitute successful leadership—military and otherwise. And contrary to Chaloux's treatment of the subject, one of those I personally find most appropriate comes from my friend and mentor Lieutenant-General Bill Carr (Retired), the former Commander of Air Command as well as a distinguished and decorated aircrew veteran of the war. In his words: "Leadership is simply the ability some have to inspire others to achieve goals. Against the most terrible odds, Harris did this, and his troops followed him to hell with unmatched dedication, success, and glory."[6]

I respect, even *applaud*, Major Chaloux's right to express her own views with respect to Harris' leadership of wartime

Bomber Command, but I cannot, in good conscience, let those published views go unchallenged. Therefore, in a future article, I shall attempt to counter in my own way both her assessment of Harris' leadership and the efficacy of area bombing. I will say at the outset that Harris' singleness of application was not without some shortcomings, but such is the fog of war. The vast majority of his strategic decisions were made in good faith, for good reasons at the time and devoid of 20/20 hindsight. Hopefully, what will appear in my article is a more balanced assessment of Bomber Command's wartime success and, by extension, the leadership provided by its commander.

Dave Bashow
Lieutenant-Colonel (Retired)
Editor-in-Chief, *Canadian Military Journal*

Abbreviations

CAR	competency, authority and responsibility
DRDC	Defence Research and Development Canada

Notes

1. Major Lynne Chaloux, "Unshakeable Faith: The Flawed Command of Bomber Harris," *The Royal Canadian Air Force Journal* 2, no. 2 (Spring 2013): 19.

2. Ibid.

3. Ibid.

4. Christina Goulter, "Sir Arthur Harris: Different Perspectives" in *The Challenges of High Command: The British Experience*, ed. Gary Sheffield and Geoffrey Till (New York: Palgrave Macmillan, 2003), 127, as cited in Chaloux, 19.

5. Chaloux, 27.

6. Bill Carr, letter to author, 7 June 2013.

Life Jackets, EBS and Poopy Suits:

My family and I emigrated from the United Kingdom to Shearwater in November 1975. Prior to this, I had been the first physician in the new Royal Navy (RN) Polaris submarine Her Majesty's Ship *Renown* and, hence, was

DCIEM's Contribution to Sea King Operations

By Dr. C. J. Brooks

au fait with all the latest marine survival equipment. Imagine my surprise, when only two weeks after reporting for duty, the aircraft captain, Stu Russell, handed me an antiquated life jacket for my first Sea King MEDEVAC (medical evacuation).

For any form of underwater escape, I thought by then that the whole world knew that the life jacket must provide 35 pounds (lbs) [15.9 kilograms (kg)] of buoyancy within five seconds with one single action. The life jacket (seen in Figure 1) was a United States Navy (USN) Mark (Mk) 2 BuAer life jacket that had been introduced into the USN in 1946 and replaced in the 1970s.[1] It was a three-chambered jacket; two chambers were filled with carbon dioxide (CO2)—8 to 10 lbs [3.6 to 4.5 kg] of buoyancy each on a hot day—and it required one's own lung power to fill the third one with an additional 10 lbs [4.5 kg] of buoyancy. (Where did you find this air when escaping from a sinking inverted fuselage?) This deficiency had obviously not filtered through to Shearwater or the Canadian Armed Forces. A second surprise was that when I was strapped into the awful tubular seat in the Sea King cabin on the port side facing athwartships, I realized that I was going to be the first person to drown in the case of a ditching. In the cold water, my breath-holding time would not be sufficient to get me to the cargo door to make an escape, and my last surprise was that no one had heard about cold shock and swimming failure: the two principal causes of drowning in cold water. Royal Canadian Navy (RCN) survival equipment, standards and training had been neglected and so had the dreadfully rundown old base hospital! The Defence and Civil Institute of Environmental Medicine (DCIEM) in Toronto was the place to turn things around and introduce some new kit. Three years later, I was posted there and was determined to start the ball rolling. The results put Canada on the map as one of the international leaders in new life-support equipment and marine standards, all originating from Sea King operations.

With the support of the late Dr. Bob Heggie, Dr. Manny Radomski and Dr. Bud Rud and funding from the Chief of Research and Development (CRAD) in Ottawa, a team (shown in Figure 2) was created in the Medical Life Support Division. Over a period of 15 years, it produced some spectacular achievements. With the assistance of Major Dale Redekopp in the Directorate of Air Requirements and Bob Askew at Mustang Apparel in Richmond, British Columbia, a new life jacket / survival vest was designed, tested and introduced not only for the Sea King community but also to replace the equally antiquated life jackets used by ejection seat and transport aircraft. This life jacket has been a commercial success; it has been exported and is now being flown by the American, Australian, Chilean, Norwegian and Swedish naval air forces.[2]

Figure 1. Two pilots exit their Sea King helicopter wearing full NBC equipment and the then outdated Mk 2 BuAer life jacket. The nuclear, biological and chemical equipment was developed by a very successful cooperative agreement between DCIEM and the Defence Research Establishments of Ottawa and Suffield. (Photo credit DCIEM)

Figure 2. The original team formed in 1978 that had such success in looking at all aspects of human factors problems in the Sea King helicopter. From left to right. Front: Spence, Brooks, Rud, Rioux and Stewart. Back: Lazowski, Firth, Morrice, Winship, Macpherson, Steffler, Kaufmann, Meek, Ford and Leben. (Photo credit DCIEM)

While in San Diego at a medical conference, I visited a dive shop and noted that the West Coast commercial divers were using a pony bottle / regulator for emergency air. This looked to be the perfect solution to provide supplementary air for use in helicopter underwater escape. I purchased a bottle and brought it back to DCIEM for the divers to evaluate. It passed with flying colours and became the basis for the emergency breathing apparatus (EBS), shown in Figure 3. We tested it with Albert Bohemier, a former Sea King pilot, in his new "Dunker" at Survival Systems Limited, and it was air certified.[3] Believe it or not, it took eight full years from the original purchase until the introduction of the Mk 1 into service. (That is another story!) The RCN is now using the Mk 2 EBS unit, and the latest Mk 3 unit has recently been introduced into the Canadian offshore industry helicopters flying out of Halifax and St. John's.[4] As a result of our work, the rest of the North Atlantic Treaty Organization (NATO) naval helicopters copied us and have been outfitted with EBS units, and many lives have been saved.

Figure 3. (Left) The six EBS that were evaluated. The Submersible Systems Inc. unit, in the middle and second from the bottom (and shown on the right), was chosen as the Mk 1. (Right) The Submersible Systems Inc. Mk 1 EBS purchased by DCIEM. It was modified with the whip hose to fit into the Sea King backpack. The Mk 1 without whip hose was later adopted by the USN as the Helicopter Emergency Egress Device (HEEDS) and the RN as the Short Term Air Supply System (STASS). (Photo credit DCIEM)

The "poopy" suit, an anti-exposure suit to assist in survival in cold water, is the most detested piece of life-support equipment but is a necessary evil. We replaced the old Beaufort double-layered, Ventile® fabric suit with a new single-layered Gore-Tex®/Nomex® suit, admittedly only a slight improvement in comfort. In the process, we purchased a thermal manikin. It now gave us the ability to

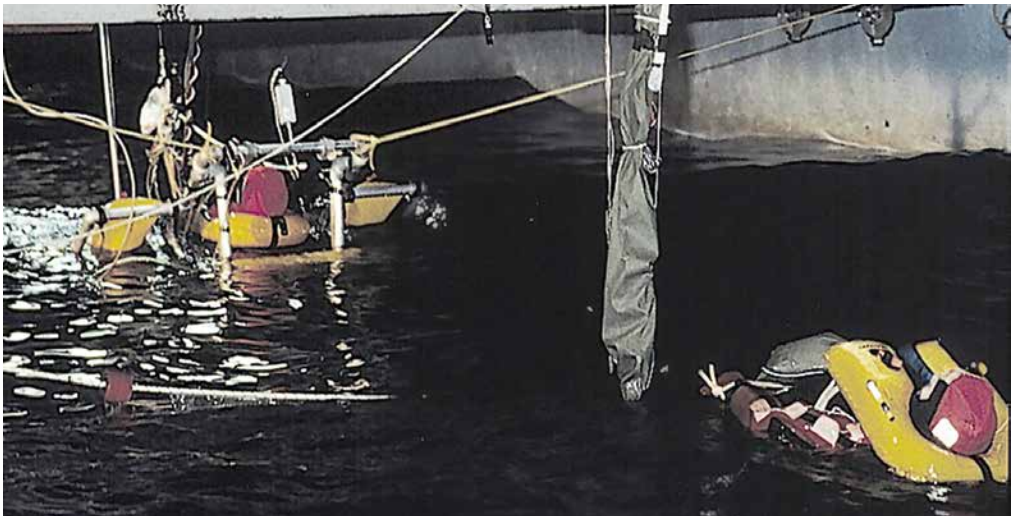


Figure 4. One subject and the thermal manikin both wear survival suits side by side in the National Research Council Institute of Marine Dynamics wave tank in St. John's, Newfoundland. (Photo credit Dr. Chris Brooks)

Figure 5. The thermal manikin wearing a survival suit being swung over the stern of HMCS ANTICOSTI during cold-water and wave trials off Halifax, Nova Scotia. (Photo credit Dr. Chris Brooks)

test out new types and layers of clothing for survival suits in cold water without having to use human subjects.[5] As a result of the tests at CORD Limited in Dartmouth and the Institute of Marine Dynamics, St. John's (see Figure 4) in their wave tanks and sea trials in HMCS (Her Majesty's Canadian Ship) ANTICOSTI (see Figure 5), we were able to establish for the first time, the loss of suit insulation created by the wave motion.[6] This made it possible to prescribe the correct amount of clothing insulation to build into a suit to match seawater temperature, wave height and the survival time before rescue. Too much buoyancy in a poopy suit means that it will hinder or even prevent a person from making an escape in an inverted flooded helicopter. So we invented a device for measuring the buoyancy (see Figure 6) and established the maximum allowable standard; this standard and the device have now been adopted worldwide.[7]

Figure 6. The first human tests of the aircrew immersion suit inherent buoyancy weighing device; this design of chair and the standard have been adopted worldwide. (Photo credit Survival Systems Ltd)

Following the *Ocean Ranger* disaster, this information made it possible to write the first standard for a commercial marine survival suit for the Canadian General Standards Board (CGSB).[8] This standard has been copied worldwide by the International Maritime Organization (IMO)[9] and the European Committee for Standardization (CEN) for their survival suit standards. Our reputation had grown so much that we were asked to form a subsidiary team with the Transport Canada Marine Safety Branch, Natural Resources (Canada), the former Canada Gas Lands Administration, the National Research Council and the CGSB to look at other human factors related to Canadian marine safety. The most notable successes were the marine safety equipment and lifeboats improvements as well as the development of the emergency evacuation procedures on the new floating production storage and offloading vessel, the *Terra Nova*, operating in the Hibernia oil field off the coast of Newfoundland.

It was a retrograde step to remove the poopy suit air ventilation system from the Sea Kings at midlife refit. Whoever made the decision had obviously never flown in a poopy suit off Roosevelt Roads in the spring or worn nuclear, biological and chemical (NBC) equipment in the summer. The Royal Air Force Institute of Aviation Medicine in Farnborough was experimenting with liquid conditioned cooling for aircrew. This gave us the idea to try this for the Sea King crews. We purchased an Accurex Aerotherm chiller that made iced water in the Boeing 747 galleys. It provided plenty of cooling capacity for four humans and was aircraft powered and certified. All we needed was to attach it to some form of vest, a manifold to distribute the cool water and a method to pass the hoses through the poopy suit without breaching either water or NBC integrity. Brilliant work by Master Corporal Jean Steffler, our safety systems technician, created some vests using the new radio-frequency, heat-sealing machine and urethane coated fabric in the lab.

To go with the vests, we invented a through-the-suit connection system and, as a result, share a patent with the Crown for this system. Several types of vests were successfully flight tested in Kiowas (CH136) during one summer in Portage, using individually worn ice packs,[10] and later with the chiller in a Sea King in Shearwater.[11] Then, bingo, quite out of the blue, I received a specific phone call from on high (i.e., CRAD) that we were to cease and desist any further research into aircrew cooling systems. (Goodness knows what precipitated this!) Not more than one week later, Dave Neil from the Directorate of Maritime Aviation called me and asked if we could help to adapt a system very quickly for deployment in the Gulf. We immediately transferred our findings and technology to Exotemp Limited in Pembroke, Ontario. They produced the final commercial product (see Figure 7) for the Gulf War, Operation FRICTION with the help of Dr. John Frim and Major Linda Bossi. Within weeks, the units were deployed for helicopters in PROTECTEUR and ATHABASKAN.[12] Because of the urgency of the request, small ice packs—as used in Portage—were carried by each crewmember rather than using the chiller.

This is a perfect example why research establishments should be given some discretionary money each year to do applied research and development (R&D) against projects that do not have a direct statement of operational requirement (SOR). In the case of the cooling systems, over a period of five years, a rough estimate of cost now would be a total of at least four professional and eight technical person years spent on the project, $250,000 for equipment, $150,000 for temporary duty and test flying hours in the Kiowa and Sea King. Without being able to do this and having the system flight tested and in embryonic form ready to transfer to industry, the Canadian Forces aircrew would have been unprotected from the heat when wearing their NBC suits and Aircrew Canadian (AC-4) masks.

Figure 7. Capt Mike Brush, the pilot on staff at DCIEM, demonstrates the cooling system that was deployed in the Gulf War. This allowed the Canadian Sea King aircrew to fly missions three times as long as our other allies. (Photo credit DCIEM)

Aircrew constantly ask me, "Why do we have to wear all this shit?" We must, for instance, provide them the reasons why the suit has to be dry and not leak, etc. We produced two marine survival videos to explain that cold shock and swimming failure were the principal causes of drowning and the need to protect the skin and muscles from rapid cooling. These videos are now being used worldwide in marine survival training establishments.[13] As a follow on, we produced a NATO lecture series and technical course on survival at sea for mariners, aviators and search and rescue personnel.[14] A team from DCIEM, the universities of Portsmouth and Dalhousie as well as Survival Systems Limited has taught this course in Canada and Europe (as far north as Latvia and as far south as Rota, Spain). It has been such a success that we were presented with the NATO Human Factors and Medicine Panel Excellence Award.

No one knew how long it would take to evacuate a full crew from an inverted, flooded, large, passenger-carrying helicopter. We needed to know this data in order to

Figure 8. The first time a mass-passenger, underwater evacuation has been conducted using a Dunker to simulate the helicopter cabin. The Survival Systems Limited Model 40 was enlarged to accommodate 18 passengers, as in the S-61 helicopter. (Photo credit Dr. Chris Brooks)

establish an SOR for escape times for the intended Sea King replacement. We constructed a large extension on Albert Bohemier's Dunker (shown in Figure 8) to represent the 18-passenger Sikorsky S-61. To everyone's amazement, it took 92 seconds for the last person to escape, and the subjects were all survival instructors or clearance divers! Half of them had to resort to using the EBS.[15] This solid evidence enabled us to establish the standard for escape times for the new Cyclone helicopter.

As a footnote, we conducted our classroom and pool training for the Latvian navy in the restored servant's quarters of the Czar's summer palace in Liepaja. On completion, the squadron commanding officer (CO) invited us to fly in his brand new Russian Mi-8 for a ride around the Baltic coast. Back in 1975 in Shearwater, whoever would have thought that could happen. Our team in the lab was supported by so many other people, both in and out of the lab; there are too many to thank without missing someone. They came from units where the acronyms are probably all defunct now, and of course, we have to thank the aircrew who had to insert rectal probes on many occasions!

Dr. Brooks was the Command Surgeon Maritime Command, the Command Surgeon Air Command, CO of Stadacona Hospital and twice CO at DCIEM.

Abbreviations

CGSB	Canadian General Standards Board
CO	commanding officer
CRAD	Chief Research and Development
DCIEM	Defence and Civil Institute of Environmental Medicine
EBS	emergency breathing apparatus
HMCS	Her Majesty's Canadian Ship
kg	kilogram
lbs	pounds
Mk	Mark
NATO	North Atlantic Treaty Organization
NBC	nuclear, biological and chemical
RCN	Royal Canadian Navy
RN	Royal Navy
SOR	statement of operational requirement
USN	United States Navy

Notes

1. C. J. Brooks, *Designed for Life: Lifejackets through the Ages* (Richmond, BC: Mustang Engineering, Hemlock Press, 1995), 53.

2. C. J. Brooks and J. A. Firth, "A Review of the Performance of the Canadian Military Aircrew Life-Preservers over the Last Twenty Years," DCIEM Report No. 83-R-29 (Toronto: DCIEM, May 1983), 4 and 9.

3. C. J. Brooks and M. J. Tipton, "The Requirements for an Emergency Breathing System (EBS) in Over-Water Helicopter and Fixed Wing Aircraft Operations," AGARDograph AG-341 (Neuilly-Sur-Seine Cedex, France: NATO Research and Technology Organization, 2001), 33 and 42.

4. C. J. Brooks, C. V. Macdonald, J. Carroll, and P. N. A. Gibbs, "Introduction of a Compressed Air Breathing Apparatus for the Offshore Oil and Gas Industry," *Aviation, Space, and Environmental Medicine* 81, no. 7 (2010): 683–87.

5. The CORD Group Limited, "Report on the Effects of Various Wave Conditions on the Insulation Values of Immersion Suit Assemblies Measured on a Thermal Instrumented Manikin," Report No. R94-018 (Dartmouth, NS: The CORD Group Limited, 1994).

6. M. B. Ducharme and C. J. Brooks, "The Effect of Wave Motion on Dry Suit Insulation and the Responses to Cold Water Immersion," *Aviation, Space, and Environmental Medicine* 69, no. 10 (1998): 957–64.

7. C. J. Brooks, "Maximum Acceptable Inherent Buoyancy Limit for Aircrew/Passengers Helicopter Immersion Suit Systems," *Applied Ergonomics* 19, no. 4 (1988): 266–70.

8. Canadian General Standards Board, "Helicopter Passenger Transportation Suit System," CAN/CGSB-65.17-M88 (Ottawa: Canadian General Standards Board, 1988).

9. International Maritime Organization, "Life Saving Appliance Code," Part 1(3) (London, UK: International Maritime Organization, July 1998).

10. C. J. Brooks, S. Livingstone, C. Bowen, and L. Kuehn, "Flight Testing of the Accurex Personnel Cooling System," DCIEM Report 79-R-44 (Toronto: DCIEM, December 1979).

11. C. J. Brooks, A. G. Hynes, C. G. Bowen, L. V. Allin, and L. A. Kuehn, "Development of a Liquid Personal Cooling System for the Canadian Armed Forces," DCIEM Report No. 81-R-11 (Toronto: DCIEM, April 1981).

12. L. L. M. Bossi, K. C. Glass, J. Frim, and J. Ballantyne, "Operation FRICTION: Development and Introduction of Personal Cooling for the CH124 Sea King Aircrew," DCIEM Report No. 93-06 (Toronto: DCIEM, January 1993).

13. *Cold Facts 1: The Dangers of Sudden Immersion in Cold Water-Cold Shock and Swimming Failure* (Toronto: Intercom Films,

July 1998); and *Cold Facts 2: The Dangers of Sudden Immersion in Cold Water-Hypothermia and Post Rescue Collapse* (Toronto: Intercom Films, July 1998).

14. C. J. Brooks and others, "Survival at Sea for Mariners, Aviators and Search and Rescue Personnel," AGARDograph HFM-106 (Neuilly-Sur-Seine Cedex, France: NATO Research and Technology Organization, 2008).

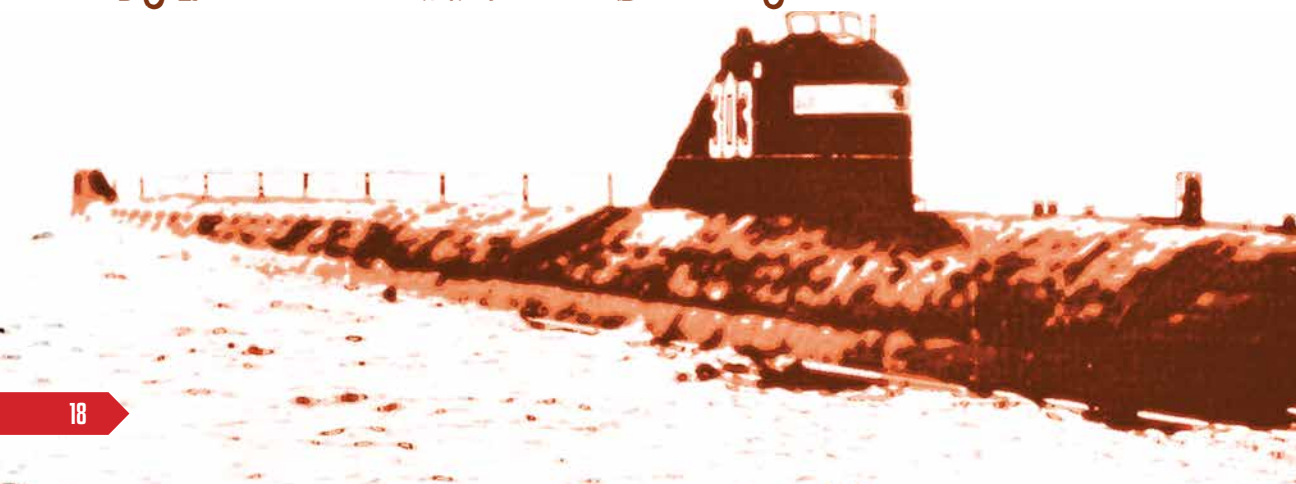
15. C. J. Brooks, H. C. Muir, and P. N. A. Gibbs, "The Basis for the Development of a Fuselage Evacuation Time for a Ditched Helicopter," *Aviation, Space, and Environmental Medicine* 72, no. 6 (2001): 553–61.

Seasprite to Sea King:

The Royal Canadian Navy's Ship-borne Antisubmarine Helicopter Capability

One of the better-known achievements of the post-war Royal Canadian Navy (RCN) is the integration of the large Sikorsky Sea King antisubmarine helicopter into small surface escorts. Of this, "radical and entirely Canadian development," Tony German writes that it was, "hugely admired" by other navies and that, "[a]fter eight years' development Canada's navy on its own brought a whole new dimension in anti-submarine [sic] warfare to the navies of the world,"[1] yet the remainder of his publication, *The Sea Is at Our Gates*, pays little deference to this accomplishment.

By Lieutenant(N) Jason Delaney

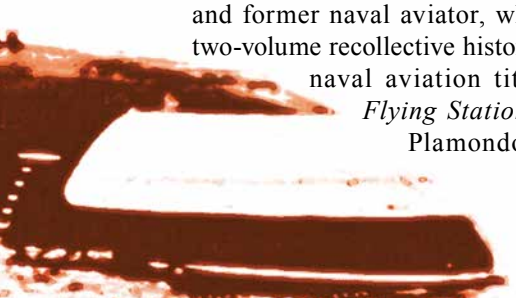


Understandably, there is very little mention of it in the final chapter of *A History of Canadian Naval Aviation* because Kealy and Russell were still writing while the helicopter/destroyer concept was being developed. What is more curious is that the proceedings of successive naval history conferences do not cover the topic sufficiently or at all. Both *RCN in Retrospect* and *RCN in Transition* barely cover the development of helicopter destroyers while *A Nation's Navy* and *People, Policy and Programmes* have no historians addressing this supposed great Canadian achievement.[2]

The centennial history published in 2010 has three authors who briefly discuss the subject within the context of challenges faced during the early-cold-war period, while Marc Milner provides one of the best, albeit short, descriptions in *Canada's Navy: The First Century*.[3] The fact remains, however, that despite the Sea King becoming an iconic workhorse serving on board Canadian warships for over half a century, only a few authors have contributed significant research to this development. Part of the reason lies in the fact that the Sea King came into service just as the naval-records system collapsed during the tumultuous period of headquarters integration and reorganization in 1964. Another part of the reason is because, until recently, many of the official records were classified.

The few authors who have managed to piece together significant material on the subject include: Peter Charlton, a former naval officer and aviation engineer with the experimental test squadron, Experimental Squadron 10 (VX 10), who contributed to *Certified Serviceable* with Michael Whitby and who wrote *Nobody Told Us It Couldn't Be Done: The VX10 Story*; Stuart Soward, author and former naval aviator, who produced a two-volume recollective history of Canadian naval aviation titled *Hands to Flying Stations*; and Aaron Plamondon who wrote *The Politics of Procurement* using the Sea King acquisition and the New Ship-borne Helicopter Project as the basis for a case study. Undoubtedly, however, the seminal work on this topic was done by Sean Cafferky, who is largely responsible for opening a great deal of the classified material. As a result, his publication, *Uncharted Waters*, is the first full treatment of the development of the ship-borne antisubmarine warfare (ASW) helicopter in Canada.[4] Although the above mentioned work pays considerable attention to the development of the concept in the mid-1950s and the integration of the Sea King into the fleet, it does not take it as far as the first operational tour at sea when the capability was ultimately proven. This is the goal that will be pursued herein, and it will be explained within the context of the larger allied ASW effort.[5] In the end, it will be shown that the marriage of the large ASW helicopter and the small surface escort, although a significant contribution to maritime warfare, was neither a radical development nor a dramatic change in antisubmarine warfare; it was simply a matter of necessity and only one example of many in which a limited ASW Navy struggled to keep up with the fast pace of technological advancements during the cold war.

First, it must be understood that developments in submarine and missile technology during the 1950s contributed to significant changes in maritime warfare. Over a relatively short period of time, contemporary weapons, sensors and tactics were considered inadequate, causing what has been referred to as the ASW crisis of the mid-1950s.[6] The world's first nuclear-powered submarine, USS (United States Ship) *Nautilus*, demonstrated that it could operate with relative immunity against the best efforts of modern ASW forces. The unique propulsion system, although noisy, allowed *Nautilus* to operate independent of the surface as well as run fast and deep to avoid detection. When discovered, *Nautilus* was difficult to track and most surface forces could not close the distance to launch their weapons; if



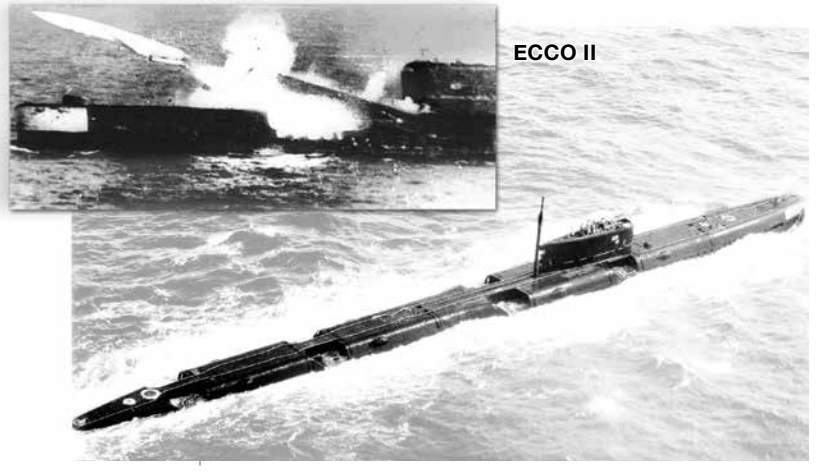
> "[O]ur confidence in the ability of the surface ship to protect a screened body against attack...was sadly misplaced."
>
> Capt A. B. F. Fraser-Harris

they did, then they were at risk of a deadly counter-attack. This innovation in propulsion systems—along with other advancements such as new hull designs, sensors, fire control systems and noise reduction techniques—allowed the submarine to evolve as a weapons platform, making them faster, quieter and more deadly. Conventional submarines also had certain advantages. Although dependent on the surface for air, they could run slowly and silently or simply lie and wait, making them very difficult to detect with anything other than active sonar. Combined with advances in missile technology and the inevitable integration of these weapons into submarines, cold-war maritime warfare took on a whole new challenge during this period.

Then, in January 1956, the Chief of the Soviet Directorate of Naval Education Institutions, Admiral L. Vladimirsky, openly discussed the potential of the guided missile-firing submarine within the Soviet press.[7] This was followed by the First Secretary, Nikita Khrushchev, announcing to the world that his navy would focus their future development on guided-missile submarines because they were the most suitable naval weapons for attacks against the United States.[8] The idea that the Soviets had this capability—combined with indications that their submarines would increasingly be engaged in "blue-water" instead of defensive coastal operations—was disconcerting.[9]

Around this same time, the RCN established the Naval Warfare Study Group to investigate ways to better align defence planning with the North Atlantic Treaty Organization's (NATOs) new Military Committee (MC) 48 strategy that identified extensive Soviet submarine operations in the Atlantic as the "principle [sic] naval threat."[10] This study group was one of many influences recommending a shift in defence planning that would bring forces closer to the continent, along with a change in focus toward new antisubmarine concepts.[11] This paralleled much of the thinking within the United States Navy (USN), and joint exercise scenarios between the RCN and USN began to encompass both contemporary convoy protection as well as the defence of North America against missile-firing submarines.

Although the RCN was considered one of the best ASW navies at the time, it struggled to keep up with these advances. Michael Whitby identifies the problem perfectly in his biographical article on one of the more colourful senior officers in the RCN at the time—Captain A. B. F. Fraser-Harris. As the commanding officer of the aircraft carrier Her Majesty's Canadian Ship (HMCS) MAGNIFICENT, he wrote a report after a series of exercises in early 1956 that was


ECCO II

critical of the state of the fleet with respect to antisubmarine warfare. In it he remarks that "our confidence in the ability of the surface ship to protect a screened body against attack, even from a contemporary submarine under controlled conditions, was sadly misplaced."[12] Fraser-Harris goes on to conclude that it was unrealistic to use the ships either in the hunter-killer role or in defence against missile-firing submarines. Notwithstanding relative success against German U-boats during the latter part of the Second World War, the age of the surface escort seemed at an end unless a way could be found to reduce the tactical advantage of the modern submarine. The small escort-type ships of the RCN needed a system that could range out with great speed and not only detect and localize but also destroy a submerged contact.[13]

By this time, many of those concerned with maritime defence began to acknowledge that the ASW helicopter was becoming increasingly more important to the future of antisubmarine warfare.[14] A respected defence scientist at the time went so far as to say that:

> With the advent of nuclear-powered submarines, the anti-submarine [sic] helicopter assumes an added importance. Because of its ability to search underwater and its relatively high speed as compared to even a nuclear-powered submarine, the helicopter's effectiveness should not be affected very much by the new development [nuclear submarines].
>
> In this respect, it is much more favourably placed than either the fixed-wing aircraft or the surface craft, and would appear an essential complement to them. Given adequate developments and a suitable vehicle, it seems likely in fact that some of the functions of both fixed-wing aircraft and escort vessels could be more efficiently performed by the anti-submarine [sic] helicopter.[15]

Subsequently, the helicopter was seen as having a large potential in the fighting role, and its value only increased when considering its relative invulnerability to counter-attack from a submarine. With this understood, the Naval Warfare Study Group recommended an increase in the RCN's ASW helicopter force to 40 aircraft by 1960.[16]

The problem was that ASW helicopters needed support facilities at sea, such as those found on-board aircraft carriers. The RCN could only afford the one carrier, and its replacement, HMCS BONAVENTURE, was due to be commissioned in 1957. Since there was little chance of obtaining a second carrier and there was a need to improve the ASW capability of the surface escorts, the idea of integrating ASW helicopters into the fleet merged, naturally, with the helicopter/destroyer concept. Some, however, urged caution, and Fraser-Harris warned that the concept should not hinder the development of the helicopter as a self-sufficient ASW platform.[17]

The RCN experimented with helicopters landing on a makeshift platform on small warships in September 1956 and November 1957.[18] From these initial experiments, several problems emerged: first, a more robust, all-weather helicopter was required that could operate day and night; second, the ship needed facilities to protect the helicopter from the elements and allow routine maintenance to be performed; and third, a method was needed to safely land and secure the aircraft on the deck in rough seas since small ships experience a greater level of pitch and roll in heavy seas than larger ones. Only if these criteria were met could a helicopter be operated safely for a greater percentage of the time in the unforgiving climate of the North Atlantic.[19]

By now, the Naval Staff began to see the ASW helicopter as having considerable potential, and NATO was urging Canada to accelerate their plans to develop this capability. The acquisition of suitable

Sikorsky HO4S Horse on HMCS BONAVENTURE

helicopters was thus given top priority.[20] Unfortunately, there were few helicopters at the time that could carry both weapons and the necessary equipment for the detection and localization of a contact and still operate from small warships in the range of 2,200-tons [1,995.8 tonnes] displacement, such as those in the RCN. The Americans and British had been experimenting with helicopters at sea since the end of the Second World War and had ASW helicopters—such as the piston-engine Sikorsky HO4S-3 (S-55) "Horse" and the British version, the Westland Whirlwind—operating from aircraft carriers by the mid-1950s, but these aircraft had limited capabilities and did not have the proper instrumentation for night operations. The RCN operated a few of these helicopters in the experimental ASW squadron, Helicopter Anti-Submarine Squadron 50[21] (HS 50), and later deployed them on board both MAGNIFICENT and BONAVENTURE in a limited capacity. Sikorsky eventually developed a better version designated the HSS-1N (S-58) "Seabat," which incorporated automatic stabilization equipment and was suitable for both day and night operations. This variant included the latest technology such as the automatic "hover coupler," which used the aircraft's radar to enable the helicopter to come to a pre-selected spot over the water and hover at 50 feet [15.2 m]; this was an important development because it allowed the helicopter to "dip" sonar in both restricted visibility and at night when the pilot's visual reference to the sea was obscured. The British version went into service with the Royal Navy (RN) as the Westland Wessex. Both the USN and RN used these helicopters extensively, and the British were developing the Wessex for operations from large destroyers in the range of the 5,200-tons [4,717.4-tonnes] displacement.[22] The problem with these helicopters was that they were based on an aircraft designed in the 1940s and were, therefore, considered obsolete.

The RCN other designs such as the Sud-Aviation Djinn, Aérospatiale Alouette, Bristol 203 and the Saunders Roe P-531 (later Westland Wasp). The latter was being developed specifically for use on board destroyers, but it could not carry both a weapon and the necessary detection equipment; therefore, it had to rely on the ship's sensors to locate a target. The Navy also considered the Piasecki/Vertol H-21, the Kaman HOK-1 and HU2K-1 as well as the Sikorsky S-62 as alternatives. In the end, only the Sikorsky, Kaman and Westland Wessex aircraft were recommended.[23]

The Kaman Aircraft Corporation was in the process of adapting its HU2K-1 Seasprite for use on board ships, but it was a single-engine, light-utility helicopter, and neither Kaman nor the USN intended to develop it as an ASW platform at this time.[24] Like the Wasp, the Seaprite was not sufficiently large or powerful enough to carry both weapons and detection equipment. Sikorsky, on the other hand, offered several good options because they were designing helicopters specifically for antisubmarine warfare. The Naval Staff liked the design of the new S-60 series because they had a boat-shaped hull for emergency landings on water, but they were very large helicopters. The S-62 was the smallest version of this series and was a single-engine, civilian-aviation model that went into service with the United States Coast Guard (USCG) as the HH-52A Sea Guard. Although this variant seemed promising, it too would have to be adapted for military use.

Kaman HUSK-1 Seasprite

The choice was narrowed down to the Seasprite, if it could be developed to carry both weapons and sensors, and another Sikorsky helicopter: the S-63. Both were powered by new turbo shaft engine technology that had just been introduced by General Electric for helicopter use. Compared to these two, all the other helicopters were considered to be either less capable or obsolete.[25] The S-63 was based on the prototype HSS-2 Sea King ASW helicopter with rotor control and transmission components of the HSS-1N (S-58) as well as three powerful engines.[26] Several senior officers favoured this design because the S-58 was already in use with the Royal Canadian Air Force (RCAF) and, therefore, parts could be standardized between the two services. They also preferred a Sikorsky helicopter because the RCN was already operating Sikorsky helicopters and the company was set up with Pratt & Whitney Canada in Montreal.[27] The S-63, however, had encountered development problems that increased the projected cost of the programme and was considered "too large and heavy for operations from escorts."[28]

The smaller Seasprite, with its single 1,100 horsepower [820.3 kilowatt] T58-GE engine, had reached the limits of its performance potential, whereas the Sea King had two 1,175 horsepower [876.2 kilowatt] T58-GE-6 engines and was the first all-weather, day/night ASW helicopter purpose-built for the hunter/killer role. However, each Sikorsky would cost over $100,000 more per aircraft than the cheaper Kaman option. After careful consideration, the Chiefs of Staff Committee (CoSC) concluded that the Seasprite was the reasonable choice for the Navy, while the Vice Chiefs considered it smaller, cheaper and easier to handle in rough weather.[29] A submission was prepared for the Cabinet Defence Committee with a recommendation that the first 12 of a 40-aircraft-acquisition programme be Kaman helicopters with no commitment as to what the remaining type ought to be.[30] These first 12 were to be a

Canadian ASW version (CHSK-1) of the HU2K-1 Seasprite at a cost of $16,321,206.[31]

Although the Seasprite seemed the right choice, there was some doubt as to whether Kaman could develop the helicopter to meet RCN needs. When this was brought to the attention of the Vice Chief of the Naval Staff (VCNS), Rear-Admiral Tisdall, he became concerned:

> If there is any doubt that after spending $16,000,000 to get 12 of these helicopters that they do not meet the staff requirements, the RCN is in an extremely embarrassing position.
>
> What CNS [Chief of the Naval Staff] requires is a clear statement on whether or not the Kaman production model with the present engine T-58-6 will do the job we require. Would the S-58 [HSS-1N] do the job we require or not?[32]

He further added:

> I am sure that you realize that the helicopter question must be settled correctly and now, as the future major programme, i.e., new construction surface vessels and conversion programme of ST. LAURENT, depends entirely on the helicopters.[33]

Tisdall was assured that there was no other choice that could operate from the RCN's destroyers, and the Kaman aircraft was being procured in a smaller number as an interim until more capable helicopters could be developed.[34] Here again, the HSS-1N was dismissed as a possible alternative.

Whatever the choice of aircraft, the helicopter needed aviation facilities built into the destroyers to shelter it from the elements and allow for routine servicing and maintenance; this meant a flight deck and hangar had to be retrofitted into existing ships for which they were not designed. The RCN

CF Photo

investigated whether all of the frigates and destroyers in the fleet could be adapted to carry helicopters as well as a combination of the new SQS 503 and variable depth (SQS 504) long-range sonar to maximize their ASW capabilities.[35] Moreover, all of the destroyers of the ST.LAURENT, RESTIGOUCHE and repeat RESTIGOUCHE (MACKENZIE and ANNAPOLIS) classes could be altered for about the same cost as one destroyer, making the conversion programme seem quite affordable.[36] Helicopters were, thus, included into the destroyer ASW improvement programme, which was a package deal including as many upgrades as could be achieved.

By June 1960, Treasury Board had approved in principle the aviation facilities for the two latest ships commencing construction, HMCS NIPIGON and HMCS ANNAPOLIS as well as the ST. LAURENT-class conversion programme.[37] Understanding the difficulty the Navy was having in finding a suitable helicopter, Treasury Board did not support the request for 12 Seasprites and, instead, wanted the department to wait until an appropriate helicopter was developed.[38] The Minister of National Defence, George Pearkes, stressed the urgency of having a decision so that the aircraft could be ready by the time the destroyers came back into service after conversion.[39] Treasury Board acquiesced and endorsed the purchase of the Seasprite, which could be accommodated in the redesigned destroyers.[40] With a decision made on the helicopter as well as the ship alterations, it now appeared as if the Navy finally had its ship-borne ASW helicopter programme underway.

However, as was anticipated by some, there were serious problems in converting the Seasprite into a feasible ASW platform, able to carry both weapons and detection equipment. The overall weight and subsequent increase in conversion costs caused grave concern about the aircraft's development potential, forcing the RCN to rethink its plan. The new

CF Photo: SLt Michael McWhinnie

CF Photo: SLt Michael McWhinnie

cost was quoted as being over $23 million, which was an increase in cost per unit to more than that of the larger, more capable Sea King.[41] Moreover, the Sea King had become a proven design and drew serious attention at a lower cost than previously reported.[42] Between the increased cost of the Seasprite and the new Sea King dependability and affordability, an argument for obtaining the latter seemed persuasive.

Yet, the Sea King was designed for carrier operations and, as mentioned, was considered too large for destroyers. In order to accommodate the helicopter in its production form, the ships would need extensive modifications that were previously considered unacceptable. The Sea King was a monster of an aircraft, being a full 10 feet [3 metres] longer and 5 feet [1.5 metres] wider than the Seasprite, even with the rotor blades and tail pylon folded. Its sheer size could not be housed in the destroyer hangars as laid out in the conversion plans. In addition to this, a way had to be found to mechanically manage the big helicopter on the small landing platform and move it into the hanger, since it could not be done manually.

The problem was that the planned aviation facilities were already as large as the engineering branch thought practical and were just enough to accommodate the Seasprite. The space aft of the flight deck was limited by the Mark 10 Limbo mortar's arcs of fire, and there was no room to expand the hangar forward because of the location of the main propulsion and machinery exhaust funnel. The solution was to split the funnel into two, which would allow the hangar to expand

HMCS ASSINIBOINE

forward while venting exhaust on either side of the forward part of the new structure.[43] This modification, however, would cause residual deficiencies that would have to be accepted. First, there was no provision for any widening of the hangar, and second, the extra 30 tons [27 tonnes] of weight would have a negative impact on ship stability.[44] Accepting this, staff planners thought that the helicopter facilities should be increased to accommodate a larger aircraft "regardless of the decision as to what type of helicopter would be embarked."[45] The urgency of the matter was critical because detailed plans of the changes would have to be communicated to the shipyards before the work commenced.[46]

The Naval Board agreed that "the HSS-2 had such advantages for the RCN ASW role that it is worthy of a detailed examination including a cost analysis."[47] However, they remained unconvinced of a programme change. The extent of structural alterations to the destroyers in order to accommodate a larger aircraft was undesirable at this point, so they directed that the hangars were to remain unaltered.[48] Discussions with the Kaman Aircraft Company continued until April 1961 when a Seasprite crashed during a demonstration flight at the Naval Air Training Center (NATC) in Patuxent River, Maryland. The naval member, Canadian Joint Staff (Washington), sent preliminary findings of the accident to naval headquarters and forecasted at least a two-month slippage in the programme.[49] After this, Naval Staff abandoned the Seasprite altogether and recommended that contractual negotiations with Kaman be delayed until after the United States (US) Navy's phase III evaluations.[50]

If the RCN were to acquire the larger Sea King, a decision to enlarge the hangar in the destroyer escorts was required. Further investigation by the Navy's technical services branch revealed that increasing the size of both the landing platform and the hanger could be done without seriously jeopardizing stability because the existing ballast tanks were sufficient to compensate for the added top weight.[51] With this, the Naval Board agreed to an increase in the aviation facilities "to enable an HSS2 helicopter to be operated and maintained."[52] The Chief of the Naval Staff, Vice-Admiral H. T. Rayner, informed the Chairman, CoSC, now Air Marshal Frank Miller, of the new developments.[53] It was explained that, aside from the destroyers, HS 50 needed a replacement for its HO4S-3 helicopters to continue operations from the carrier. An interim acquisition of 10 Sikorsky HSS-2 ASW helicopters was now seen as offering superior value than any other choice.

The sudden change left Miller puzzled. As the former deputy minister, he was well aware of the Navy's fight to acquire helicopters, and he was also surprised by the experimental ASW helicopter unit, HS 50, being referred to as an operational squadron. Before answering Rayner's request, Miller dispatched the committee's secretary,

Lieutenant-Colonel D. W. Blyth, to meet with the Director of Naval Aircraft Requirements (DNAR), Captain V. J. Wilgress, to get more answers.[54] Not only was the question of HS 50's status an issue, but it had occurred to Miller that the RCN had shifted its focus by placing priority for acquiring effective ASW helicopters on rearming HS 50 and the carrier instead of the helicopter/destroyer programme. Wilgress confirmed that the Navy was attempting to form an operational ASW helicopter squadron that could operate from the carrier; this is what HS 50 had been doing with the Sikorsky HO4S-3 in BONAVENTURE and is what the Sea King was specifically designed for. The helicopter requirement for the destroyer escorts was described as a second and separate issue and one that had not yet been resolved. Wilgress confessed to Blyth that the Kaman helicopter may still prove to be the most suitable for the destroyer role. The idea of obtaining two different helicopters now became a problem.[55]

By characterizing HS 50 as a shore-based squadron to supply the carrier, the RCN could keep the unit safe from RCAF control because, at the time, the two services were fighting over control of maritime aviation. The CoSC had already made the decision that the RCN could only control aircraft operating from ships; therefore, if HS 50 were considered an operational carrier squadron, then the unit would have a legitimate sea-going role, even if it were stationed ashore at the naval air station at SHEARWATER.[56] Miller explicitly pointed out that "while the Chiefs of Staff had approved a small naval helicopter unit for test and development purposes, there appeared to be no formal approval on record authorizing an operational anti-submarine helicopter squadron."[57] The goal of developing a new ASW weapons system for the Navy's surface escorts had clearly evolved.

While this debate was going on, the Navy's Sea King evaluation team determined that the operational, financial and technical implications of the HSS-2 were well within the RCN's capabilities and resources; furthermore, the aircraft fully met the requirements, including the ability to operate from an escort vessel. There were, however, some additional conditions that needed to be met.[58] First, the rotor blades and tail section would overhang the flight deck; therefore, an automatic system for folding them was necessary. Second, the increased weight of the Sea King would place an additional load on any securing and moving device, requiring a stabilization system for the ship to limit the amount of movement experienced in heavy sea states.[59] Provided these additional criteria were met, the Sea King was a viable option.

With this, the Navy presented recommendations to acquire 10 HSS-2 helicopters for HS 50, but Treasury Board rejected the plan.[60] They believed that since the Kaman procurement had experienced complications and caused much consternation, the Sikorsky one might as well. Treasury Board demanded further trials and a demonstration that the Sea King could, in fact, be operated from the destroyers.[61] The demonstration took place in the spring of 1962 at the Sikorsky manufacturing plant in Stratford, Connecticut. An American Sea King was used along with a makeshift haul-down winch system. Representatives present included those from the Treasury Board, Department of National Defence, USN and the USCG.[62]

The demonstration was a success and the initial procurement was reduced to eight helicopters with the possibility of a follow-on programme for a total of 44 in order to equip HS 50 for operations from the carrier and to outfit the destroyers. A potential order this large now invited the prospect of Canadian production and industrial benefits. With this to consider, the Minister of Finance, George C. Nowlan, brought up the possibility to the Minister of National Defence, Douglas Harkness (who had succeeded Pearkes after the last federal election). The programme now had political appeal, and Harkness agreed.

On 26 September 1962, the procurement proposal was put before the Treasury Board who agreed with the purchase of three HSS-2 Sea King helicopters direct from Sikorsky with the follow-on production of five helicopters in Canada.[63]

After this decision, the Minister of Finance referred to the programme as potentially being "a significant accomplishment for Canadian industry."[64] As numerous authors who have written on military procurement have proven, military procurement programmes are often used to stimulate Canadian industry, particularly in times of recession.[65] Canada had entered a recession in 1957, and the early 1960s became a period of both increasing austerity and high inflation. The option of a potentially large programme involving domestic production became quite lucrative to a struggling government facing an economic slump and high unemployment rates. Eventually, 41 aircraft were procured, all of which—except the first four—were assembled at the United Aircraft Company's

CF Photo: MCpl Robin Mugridge

plant in Longueuil, Quebec, near Montreal. These helicopters were originally categorized as Canadian variants of the HSS-2 and designated CHSS-2, but they would later be redesignated as CH124 Sea Kings to align with the Air Force classification system.

By May 1963, HS 50 began preparing to accept the first Sea Kings; however, helicopter/destroyer trials by VX 10 had to wait until the first ship, HMCS ASSINIBOINE, completed her conversion and transferred to the East Coast later in the fall. One of the big questions that still remained was whether all the necessary maintenance tasks could be performed on board, up to and including a full

HMCS ASSINIBOINE

engine change. The intent was to allow for enough work space "to supply those services required for scheduled maintenance at the squadron level."[66] The problem was that the maintenance capability of a ship at sea was limited by hangar space and ship's motion. Unfortunately, the narrow hangar originally designed for the conversions was based on the smaller Seasprite, and whereas the length of the hangar had been increased with the splitting of the funnel, the width had not.[67] After the initial fit into ASSINIBOINE's hangar in November 1963, it became obvious that the space had to be widened by 5 feet [1.5 metres] to allow for proper equipment stowage and movement around the aircraft. This was eventually done, and by the time the first ship was ready to embark a helicopter detachment for an operational tour, all major maintenance could be performed on board.[68]

The next problem was to devise a method of safely landing and securing the aircraft in rough conditions. The RCN, in partnership with the local aviation industry, developed the idea of a winch-down system that could also traverse the helicopter along an axis from the platform into the hangar. This was accomplished through another Canadian innovation known as the Helicopter Hauldown and Rapid Securing Device (HHRSD) or "Beartrap." Other navies were developing similar systems at the time, but none took the concept as far as the RCN because none were trying to do what the Canadians were doing with the Sea King. Initially, the helicopter was supposed to be introduced into the fleet by 1965. Indeed, a squadron of six Sea Kings embarked in BONAVENTURE for the first time for the annual RCN/USN SPRINGBOARD exercises near Puerto Rico.[69] Delays in the development and acceptance of the Beartrap, however, prolonged the first operational detachment deploying in a destroyer until two years later in May 1967.[70] The problem with the system was the haul-down control, which caused the cable to snap repeatedly under heavy strain. Up until this point, the trials team from VX 10 was using a dockyard fix of the device to progress evaluations. A solution was eventually found, and a new version of the prototype was successful.

The next phase of integrating the helicopter into the fleet required the deployment of a helicopter air detachment (HELAIRDET) on a destroyer for an operational tour. In the summer of 1965, HS 50 was finally designated as an operational ASW helicopter squadron. By the fall of 1966, eight of the nine helicopter destroyers (DDH) were recommissioned into the fleet and were either ready to commence or were already conducting readiness trials or "work-ups." ANNAPOLIS, under the command of Commander D. Mainguy, completed final trials and achieved stage one helicopter capability status in September 1966.[71] Since the ship was scheduled for an

upcoming maintenance and training cycle, her sister ship, NIPIGON, was selected to take over trials.[72] The Beartrap was installed and certified in NIPIGON by the end of 1966, and a HELAIRDET from HS 50 was formed for NIPIGON.[73] Since BONAVENTURE had gone into her extended midlife refit in Montreal and NIPIGON was still conducting trials with VX 10, there were no ships cleared for helicopter operations available during the annual SPRINGBOARD exercises in the Caribbean. Instead, the squadron operated ashore from the US Naval Air Station at San Juan, Puerto Rico.

By March, NIPIGON completed helicopter trials and received a Clearance for Service Use (CSU) for stage one flight operations using visual flight rules (VFR); this allowed for daytime and limited night flights in good visibility.[74] The following month, ANNAPOLIS completed her combat readiness inspection and received her daytime clearance.[75] At this point, an HS 50 detachment had still not deployed to a destroyer for an operational tour. A common belief is that HMCS ANNAPOLIS was the first to have a successful deployment (with Sea King 4030).[76] Whereas it is true that the detachment, led by Lieutenant-Commander J. Véronneau, joined ANNAPOLIS on 26 May 1967;[77] this was neither the first operational HELAIRDET formed by HS 50 nor was it the first to embark in a helicopter destroyer. It seems reasonable to assume, then, that NIPIGON was the first. Indeed, according to

HMCS ANNAPOLIS

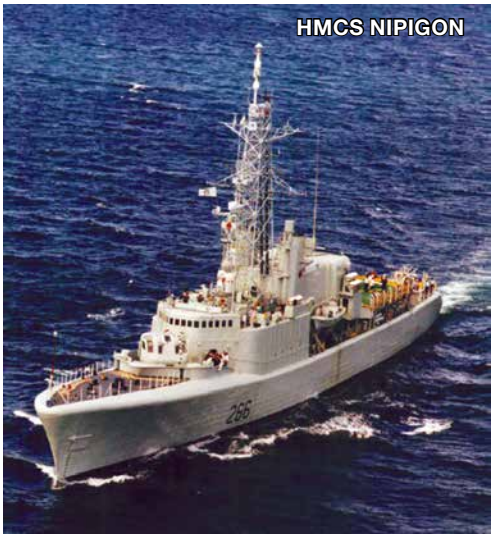
the RCN Pink Lists (operations schedules), she was listed for the task, and HS 50 appropriately formed its first HELAIRDET in January 1967 for precisely this purpose. But for some reason, the date was pushed back and NIPIGON would not have an operational HELAIRDET embark until later that summer.

The first DDH warship to have an HS 50 HELAIRDET for an operational deployment was actually HMCS SAGUENAY in early May.[78] ANNAPOLIS had received the redesigned control system for the HHRSD in September 1966, but it had been transferred to NIPIGON when the latter ship took over trials. As a result, ANNAPOLIS would not receive a CSU for the new redesigned Beartrap until April 1967. According to the annual report for HS 50, SAGUENAY's HELAIRDET was the first fully operational detachment and the first from HS 50 to use the Beartrap system.[79]

By the time Véronneau's detachment joined ANNAPOLIS, SAGUENAY had already been cleared for helicopter operations and was seconded to the NATO Exercise MATCHMAKER squadron with her HS 50 HELAIRDET on board.[80] On top of this, the ship reached the NATO squadron berthed in Newport, Rhode Island, only to receive orders to depart for an emergency situation. The ship was ordered to rendezvous with the Navy's new operational support ship, HMCS PROVIDER, in the eastern Atlantic due to a growing crisis in the Middle East.

At the time, PROVIDER possessed the RCN's second largest sea-going aircraft facilities and did not require a Beartrap for mechanical assistance to operate Sea Kings; in fact, when fully loaded, the support ship boasted a larger displacement than the carrier, making her a very stable platform for helicopter operations. Since BONAVENTURE was in refit, PROVIDER and SAGUENAY were the only ships able to take the Sea Kings on the mission. SAGUENAY with her Sea King, together with PROVIDER carrying three, were to stand ready in anticipation of recovering the

HMCS PROVIDER



Canadian peacekeeping contingent from the Gaza Strip prior to the eventual outbreak of what would become known as the Arab–Israeli Six Day War.[81]

So if NIPIGON and ANNAPOLIS were cleared for helicopter operations around the same time as SAGUENAY, the question remains: what happened to these two ships? There is no clear answer for NIPIGON since her annual historical report (AHR) that covers the period could not be located. According to her ship's logs, however, she spent much of the first three months of 1967 in harbour routine at Her Majesty's Canadian (HMC) Dockyard in Halifax, periodically progressing trials with VX 10.[82] From this, it can be assumed that the ship either entered a maintenance and coursing phase of the ship's cycle or VX 10 was still conducting trials. She eventually set sail for Bermuda in April for a paint ship routine and did not return until the end of the month.

As for ANNAPOLIS, the answer is that she struck a log and damaged one of her brand new 5-bladed noise-reduction propellers during a visit to Bathurst, New Brunswick.[83] When the Middle East crisis erupted, ANNAPOLIS was out of water in the graving dock in Halifax affecting repairs, meaning SAGUENAY was the only fully operational DDH able to deploy with PROVIDER.[84] With the conflict heating up sharply, RCAF Transport Command was eventually called in to remove the contingent while the ships were still 125 miles [201.2 kilometres] west of Gibraltar.[85] SAGUENAY and PROVIDER stood down, reversed course and headed back to Halifax. The ships arrived in harbour the same day ANNAPOLIS was floated and fuelled, with Véronneau's HELAIRDET on board. According to official records, ANNAPOLIS went to flying stations for the first time with an HS 50 detachment on board the same day SAGUENAY arrived back in Halifax after her ordeal with PROVIDER on the other side of the Atlantic.[86]

Having been assigned to the NATO squadron and ordered to a crisis with her Sea King detachment makes SAGUENAY the rightful holder of the distinction of embarking the first HELAIRDET on a DDH for an operational tour. The detachment in ANNAPOLIS, however, was responsible for producing the first manual of standard operating procedures for helicopter operations from DDH ships. For this reason, the ANNAPOLIS HELAIRDET also deserves distinction.[87]

Phase one of the evaluations into the extent to which a CHSS-2 Sea King could be supported in a DDH destroyer was completed by 1968, but the concept of helicopter/destroyer ASW operations would not evolve to include multiple ships and aircraft until later in 1969.[88] In addition to this, full certifications would not be granted for all weather, day/night operations until a reference system was developed to assist the pilot in overcoming disorientation when landing at night and in restricted visibility.[89] This did not happen until the horizon bar was perfected and trialed on board ASSINIBOINE in 1970.[90] Only at this point can it be said that the RCN finally achieved its goal of an all-weather, day/night ASW helicopter capability on board its destroyers.

As mentioned at the beginning, at least one author states that the integration of an antisubmarine helicopter into a destroyer was a radical development and was the envy of other navies while another ventures as far as stating that it "dramatically changed naval warfare."[91] Whereas this may be true from the perspective of a small navy such as the RCN, it is not from allied ASW perspective as a whole. Originally, the helicopter/destroyer concept came about because of the obsolescence of the escort destroyer when dealing with modern submarines. In this case, the aircraft is seen as an extension of the ship's capabilities. Realistically, single ASW helicopters operating from destroyers are limited in what they can do in convoy protection, barrier or search and destroy scenarios when faced with a determined enemy submarine. Major exercises and operations such as the Submarine Launched Assault Missile Exercise (SLAMEX) series as well as surveillance operations during the Cuban Missile Crises in 1962 indicated that proper surveillance and the prosecution of contacts in an open ocean environment such as the northwest Atlantic is a daunting task—even if the adversary is a conventionally powered submarine.[92] Effective ASW requires an integrated effort involving every available weapon and sensor from fixed sound surveillance systems, surface ships, aircraft and submarines. This is why in 1956, the Naval Warfare Study Group also recommended the integration of the local RCN and maritime air headquarters of the RCAF into a single command on each coast. Only in this way could the RCN better incorporate the medium- and long-range patrol capabilities of the P2V-7 (CP-127) Neptune and CL-28 (CP-107) Argus maritime patrol aircraft into the overall ASW effort within each Canadian area of responsibility.[93]

The USN and RN focused much of their efforts on ASW carrier groups and large hunter-killer submarine forces. The American navy figured out early in the cold war that the best platform to hunt and destroy an enemy submarine is actually another submarine; this is why they concentrated so much effort on the development of their all-nuclear attack submarine (SSN) force. During the 1950s, some within the RCN aggressively campaigned for acquiring SSNs and for retaining MAGNIFICENT as a specialized ASW helicopter carrier for exactly this reason, but financially, neither option could be supported. The helicopter/destroyer concept, therefore, did not dramatically change naval

HMCS BONAVENTURE

warfare; it simply added another valuable tool to an already existing tool box.

Simply put, the RCN carried on with what it could. HS 50 operated its HO4S-3 helicopters from MAGNIFICENT as an ASW squadron in 1956 and would do so with frequency later in BONAVENTURE after "Maggie" was paid off. By early 1965, the squadron embarked the first Sea Kings in "Bonnie" for major exercises in the Caribbean. Eventually, they established that out of a carrier squadron of six Sea Kings, two could be maintained concurrently in the air 24 hours a day for a period up to 10 days in what is referred to as sustained operations (SUSTOPS).[94] The reason this is so important is because exercises throughout the period established that a minimum of two aircraft were required to maintain contact because of the aircraft's short endurance "on station." In comparison, the destroyer's air detachment could maintain a single Sea King on sustained operations for a period in excess of 12 hours.[95]

Whereas a carrier squadron could rotate aircraft to and from a contact area, a destroyer could not because the helicopter would have to return to the ship periodically to refuel. This and the transit time are referred to as "dead time" during which the target submarine is afforded the chance to escape.[96] For this reason, a carrier squadron was actually more effective in ASW than one helicopter deployed from a destroyer. Unfortunately, by the time the first Canadian destroyer deployed with her full all-weather, day/night ASW potential, the carrier HMCS BONAVENTURE was decommissioned. From this point forward, the RCN had no choice but to operate their Sea Kings solely from its destroyers.

In conclusion, developments in submarine and missile technology during the 1950s were some of the more significant for maritime warfare during the cold war. Because of this, the RCN was forced to adapt or face obsolescence with respect to its surface ships and its central role

HMCS BONAVENTURE

of antisubmarine warfare. The age of the surface escort was at an end unless a system could be found that could range out and not only detect but also destroy an enemy submarine; this became the role of the ship-borne ASW helicopter, which led to innovation and success within the RCN. Unfortunately, only the seven ST. LAURENT class and two ANNAPOLIS class were ever converted to carry the Sea King as the 1960s proved to be turbulent years, financially and organizationally, for the Canadian Armed Forces. Of the seven RESTIGOUCHE class destroyers, four would later be fitted with the antisubmarine rocket (ASROC) torpedo system while the MACKENZIE class remained without any ASW upgrades and were eventually reassigned to the training squadron on the West Coast.

Interestingly, the British were quite successful in adapting their HSS-1N variant, the Westland Wessex, into a fully capable gas-turbine ASW helicopter, able to operate from their large *County*-class guided-missile destroyers. The helicopters went into service with the Fleet Air Arm in 1961, while the first *County*-class destroyer, Her Majesty's Ship *Devonshire*, was commissioned in November 1962, ahead of the converted ST. LAURENT class. If the RCN had selected the Wessex for its ship-borne helicopter programme, the modifications to its ships would have been less extensive because the dimensions of the Wessex (with rotor blades and tail pylon folded) were similar to that of the Seasprite for which the original aviation facilities were designed. The Sea King, however, outperformed the Wessex considerably in all categories.

In the end, the RCN successfully adapted some of its ships for heavy ASW helicopter operations and pioneered this new capability, thereby making a significant contribution to the allied ASW effort during an important period of the cold war. After the unification of the three armed services in 1968, what was left of this part of Canada's naval aviation legacy became the responsibility of the air element, who continued to operate the venerable Sea King from frigates and destroyers at sea for the next four and a half decades. With this, the Navy's ship-borne helicopter capability was firmly and competently secured by Canada's professional Air Force, which will no doubt continue to do so with future maritime helicopters.

Lieutenant(N) Jason Delaney is a Reserve maritime surface and sub-surface (MARS) officer on active duty as a staff historian with the Directorate of History and Heritage (DHH). Since 2003, he has been working with the post-war naval history team on volume III of the official history of the Royal Canadian Navy, 1945–68. He is a designated co-author of the volume and recently finished a draft chapter on the Navy's most controversial period involving the unification of the Canadian Forces in the 1960s. Lt(N) Delaney holds a Master of Arts from the University of Waterloo, and his field of expertise includes naval procurement and ASW developments during the cold war. Currently, Lt(N) Delaney is working on the maritime air component of the official history of the RCAF in the post-war era.

Abbreviations

ACNS(A&W)	Assistant Chief of the Naval Staff (Air & Warfare)
AHR	annual historical report
ASW	antisubmarine warfare
CNIB	*Canadian Naval Intelligence Bulletin*
CNS	Chief of Naval Staff
CANFORCEHED	Canadian Forces Headquarters
CCoS	Chairman, Chiefs of Staff
CoSC	Chiefs of Staff Committee
CSU	Clearance for Service Use

DDH	destroyer helicopter carrying
DGMS	Director General Maritime Systems
DHH	Directorate of History and Heritage
D/MND	Deputy Minister of National Defence
DNAR	Director of Naval Aircraft Requirements
DTG	date-time group
DUSW	Director of Under Sea Warfare
HELAIRDET	helicopter air detachment
HHRSD	Helicopter Hauldown and Rapid Securing Device
HMCS	Her Majesty's Canadian Ship
HS 50	Helicopter Anti-Submarine Squadron 50
LAC	Library and Archives Canada
MND	Minister of National Defence
NATO	North Atlantic Treaty Organization
NB	Naval Board
NPCC	Naval Policy Co-ordinating Committee
NS	Naval Staff
RCAF	Royal Canadian Air Force
RCN	Royal Canadian Navy
RG	Record Group
RN	Royal Navy
SSN	nuclear submarine
TB	Treasury Board
US	United States
USCG	United States Coast Guard
USN	United States Navy
VCNS	Vice Chief of Naval Staff
VCoSC	Vice Chiefs of Staff Committee
VX 10	Experimental Squadron 10

Notes

1. Commander Tony German, *The Sea Is at Our Gates: The History of the Canadian Navy* (Toronto: McClelland & Stewart Inc, 1990), 9, 244.

2. J. D. F. Kealy and E. C. Russell, *A History of Canadian Naval Aviation* (Ottawa: Queen's Printer, 1967); James A. Boutilier, ed., *RCN in Retrospect, 1910–1968* (Vancouver: University of British Columbia Press, 1982); W. A. B. Douglas, ed., *RCN in Transition, 1910–1985* (Vancouver: University of British Columbia Press, 1988); Michael Hadley, Rob Huebert, and Fred W. Crickard, ed., *A Nation's Navy: In Quest of Canadian Naval Identity* (Montréal–Kingston: McGill-Queen's University Press, 1996); and Richard H. Gimblett and Richard O. Mayne, ed., *People, Policy and Programmes: Proceedings of the 7th Maritime (MARCOM) Historical Conference (2005)*, (Trenton: Canadian Naval Heritage Press, 2008).

3. See Isabel Campbell, "A Brave New World, 1945–60" in *The Naval Service of Canada: The Centennial Story*, ed. Richard Gimblett (Toronto: Dundurn, 2009); Richard Mayne, "Years of Crisis: The Canadian Navy in the 1960s" in *The Naval Service* (see this note); Peter Haydon, "From Uncertainty to Maturity, 1968–89," in *The Naval Service* (see this note); and Marc Milner, *Canada's Navy: The First Century* (Toronto: University of Toronto Press, 1999).

4. Peter Charlton and Michael Whitby, ed., *"Certified Serviceable" Swordfish to Sea King: The Technical Story of Canadian Naval Aviation by Those Who Made It So* (Ottawa: CNATH Book Project, 1995); Peter Charlton, *Nobody Told Us It Couldn't Be Done: The* VX 10 *Story*, 2nd ed. (Ottawa: privately printed, 1995); Stewart E. Soward, *Hands to Flying Stations: A Recollective History of Canadian Naval Aviation*, vol. 1, *1945–1954* (Victoria, BC: Neptune Developments, 1995); Stewart E. Soward, *Hands to Flying Stations: A Recollective History of Canadian*

Naval Aviation, vol. 2, *1955–1969* (Victoria, BC: Neptune Developments, 1995); Aaron Plamondon, *The Politics of Procurement: Military Acquisition in Canada and the Sea King Helicopter* (Vancouver: UBC Press, 2009); and Michael Shawn Cafferky, *Uncharted Waters: A History of the Canadian Helicopter-Carrying Destroyer* (Halifax: Centre for Foreign Policy Studies, 2005).

5. This paper is based on larger research conducted for volume III of the official history of the RCN, 1945–1968. The author is indebted to Michael Whitby, senior naval historian, and Isabel Campbell for sharing their views and offering comments on early drafts. Any views, errors or omissions remain the responsibility of the author.

6. See Chapter 7 of Norman Friedman's, *U.S. Submarines Since 1945: An Illustrated Design History* (Naval Institute Press: Annapolis, 1994).

7. *Canadian Naval Intelligence Bulletin* (*CNIB*), vol. III, no. 8, January 1956, 3–4.

8. *CNIB*, Vol. IV, no. 4, July–August 1956, 2–3.

9. See Michael Whitby, "Fouled Deck: The Pursuit of an Augmented Aircraft Carrier Capability, Part 2, 1956–64," *Canadian Air Force Journal* 3, no. 4 (Fall 2010): 6–20.

10. Memo from VCNS to CNS and others, 23 October 1956, attached to Naval Board (NB), 508–9, 24 October 1956, DHH, 81/520/1000-100/2, box 25, file 1.

11. Isabel Campbell, "A Transformation in Thinking: The RCN's Naval Warfare Study Group of 1956," in *People, Policy and Programmes* (see note 2), 166; and Campbell, "A Brave New World," 134, 136.

12. As quoted in Michael Whitby, "Views from a Different Side of the Jetty: Commodore A. B. F. Fraser-Harris and the Royal Canadian Navy, 1946–1964," *The Northern Mariner* 22, no. 1 (January/February 2012): 12.

13. Mayne, 146.

14. Naval Staff (NS), 504-6, 12–26 December 1950, DHH, 81/520/1000-100/3, box 33, file 3; NS, 557-1, 7–20 May 1953, DHH, 81/520/1000-100/3, box 34, file 1; and Whitby, "Views from a Different Side," 13.

15. *CNIB*, Vol. III, no. 5, October 1955, 37–40, DHH, 91/128.

16. Memo from VCNS to CNS and others, 23 October 1956, attached to NB, 508–9, 24 October 1956, DHH, 81/520/1000-100/2, box 25, file 1.

17. Campbell, "A Transformation in Thinking," 178; and Whitby, "Views from a Different Side," 13.

18. In HMCS BUCKINGHAM during September 1956 and in HMCS OTTAWA during November 1957.

19. Results of these trials were reported in COMOPVAL Project Staff/SE 18, dated 1 February 1957, Library and Archives Canada (LAC), Record Group (RG) 24, 1983-84/167, box 3827, file 8260-11, pt. 2.

20. Memo from Director of Under Sea Warfare (DUSW) to Assistant Chief of the Naval Staff (Air & Warfare) ACNS(A&W), dated 4 February 1959, DHH, 79/246, box 10, file 81; Memo from CNS to Chairman, Chiefs of Staff (CCoS) with draft submission to the Cabinet Defence Committee, dated 10 April 1959, DHH, 79/246, box 10, file 81; and Appendix "A" to minutes of 4/59 meeting of NS, 24 April 1959, DHH, 81/520/1000-100/3, box 35, file 1.

21. In 1952 the RCN adopted the USN naval air squadron designations. See Kealy and Russell, 56. Therefore, squadron names

were written with the squadron number following the description. HS 50 appears in Canadian Forces Organization Order 9.5.2 (18 March 1968) as Helicopter Anti-Submarine Squadron 50. In mid-1968, the naval air squadron designations were changed to place the number before the description. HS 50 thus appears in Canadian Forces Organization Order 9.5.2 (24 June 1968) as 50 Helicopter Anti-Submarine Squadron.

22. Although the S-58 was originally designed with a piston engine, Wessex adapted it with a gas turbine engine to become the world's first to be manufactured in large quantity. They went into service on board British aircraft carriers and *County*-class destroyers in 1961–1962. Owen Thetford, *British Naval Aircraft since 1912* (London: Putnam & Company, 1958), 354.

23. "Brief on ASW Helicopters in the RCN," no date, DHH, 86/377.

24. The Seasprite would eventually be adapted for ASW but not until the Light Airborne Multi-Purpose System (LAMPS) programme in the 1970s.

25. Memo from VCNS to CNS, dated 18 September 1959, DHH, 79/246, box 10, file 81.

26. *Jane's All the World's Aircraft, 1959/60* (Toronto: McGraw-Hill, 1960), 382–83.

27. Vice Chiefs of Staff Committee (VCoSC), 48 item I, 12 December 1958, DHH 73/1223, series 3, box 62, folder 1308; and Memo from VCNS to CNS, dated 11 December 1958, DHH, 79/246, box 10, file 81.

28. Memo to DUSW from Assistant/Chief of Naval Technical Services (Air) A/CNTS(Air), dated 5 January 1959, DHH, 79/246, box 10, file 81; and Memo to ACNS(A&W) from DUSW, 6 August 1959, DHH, 79/247, box 10, file 81.

29. CoSC, 628 item IV, 29 January 1959, DHH, 73/1223, box 63; and memo from Sec. VCoSC to Sec. CoSC, dated 18 September 1959, DHH, 79/246, box 10, file 81.

30. "Helicopter Summary," DHH 86/377; and CSC 648, 5 November 1959, DHH, 73/1223, box 63, file 1310A.

31. Draft memo to Cabinet Defence Committee (CDC), December 1959, DHH, 79/247, box 10, file 81.

32. Memo from VCNS to ACNS(A&W), dated 17 December 1959, DHH, 79/246, box 10, file 81.

33. Ibid.

34. Memo from ACNS(A&W) to VCNS/CNS, dated 18 December 1959, DHH, 79/246, box 10, file 81.

35. NS 11/58-2, 24 June 1958, DHH, 81/520/1000-100/3, box 35, file 1.

36. NB 584-4, 16 January 1959, DHH, 81/520/1000-100/2, box 25, file 4.

37. Treasury Board (TB) 566257, 16 June 1960, attached to letter from TB to Deputy Minister of National Defence (D/MND), 23 June 1960, DHH, 79/246, box 10, file 81; and "Helicopter Summary." The TB approved the Improved ST. LAURENT programme on 23 June 1960. NB, special meeting, 22 July 1960, DHH, 81/520/1000-100/2, box 25, file 5.

38. "Helicopter Summary"; and letter from TB to D/MND, 5 October 1960, DHH, 79/246, box 10, file 81.

39. Memo from Minister of National Defence (MND) to TB, September 1960, DHH, 79/246, box 10, file 81; and letter from MND to TB, no date, LAC, RG 24, acc. 1983-84/167, box 3427, file 7820-102, vol. 3.

40. The sketch design of the ANNAPOLIS class given to the VCNS, Rear-Admiral Tisdall, in 1959, clearly shows the hangar with a silhouette of a Kaman Seasprite inside the hangar and aft of the main funnel. DHH, 79/246, box 2, folder 6.

41. NB, 643-1, 27 January 1961, DHH, 81/520/1000-100/2, box 26, file 1.

42. Cafferky, 288; and Naval Staff Paper, "ASW Helicopter Procurement," dated 18 January 1961, DHH, 79/246, box 10, file 81.

43. The Naval constructor branch was asked to conduct a design study to find a solution to accommodate the HSS-2, and it was presented as an appendix in a Naval Staff paper. In his published memoirs, then ACNS(A&W), Commodore J. V. Brock, claims he came up with the idea during a meeting with the Naval Staff. Shawn Cafferky, however, attributes the solution to the Naval Constructer-in-Chief, Commodore Freeborn, with introducing this solution. Jeffry V. Brock, *With Many Voices: Memoirs of a Sailor*, vol. II, *The Thunder and the Sunshine* (Toronto: McClelland and Stewart, 1983), 82; and Cafferky, 310.

44. NB, 643-1, 27 January 1961, DHH, 81/520/1000-100/2, box 26, file 1; and Appendix "C" to 7820-102 (Staff) "ASW Helicopter Procurement," 18 January 1961, 79/246, box 10, file 81.

45. Minutes of a Meeting Held in Director of Naval Ship Requirements (DNSR) on Wednesday, 18 January 1961, DHH, 79/246, box 10, file 81.

46. Ibid.

47. NB, 643-1, 27 January 1961, DHH, 81/520/1000-100/2, box 26, file 1.

48. Ibid.

49. Naval Message DTG (date-time group) 181726Z Apr 62, LAC, RG 24, acc. 1983-84/167, box 3344, file 7801-102-5, pt. 3.

50. Memo from ACNS(A&W) to VCNS, dated 8 August 1961, DHH, 79/246, box 10, file 82; Naval Policy Co-ordinating Committee (NPCC), 217-3, 9 August 1961, DHH, 79/246, Box 2, folder 4; and NPCC, 218-4, 15 August 1961, DHH, 79/246, folder 4.

51. NPCC, 218-4, 15 August 1961, DHH, 79/246, folder 4; and NB, 657-1, 23 August 1961, DHH, 81/520/1000-100/2, box 26, file 1.

52. NB, 657-1, 23 August 1961, DHH, 81/520/1000-100/2, box 26, file 1.

53. Letter from CNS to CCoS, dated 23 October 1961, LAC, RG 24, acc. 1983-84/167, file 7820-102, vol. 3.

54. The details of Blyth's visit and the questions that the chairman wanted answered are outlined in a memo from DNAR to VCNS, dated 27 October 1961, LAC, RG 24, acc. 1983-84/167, box 3427, file 7820-102, vol. 3.

55. Ibid.

56. Letter to Sec, CoSC, from DNAR, dated 26 October 1961, LAC, RG 24, acc. 1983-84/167, box 3427, file 7820-102, vol. 3.

57. The squadron would not be officially designated as an operational squadron until July 1965, after it had deployed aboard the carrier for major exercises in the Caribbean during Ex SPRING BOARD '65. CoSC 704, item III, 9 November 1961, LAC, RG 24, acc. 1983-84/167, box 3427, file 7820-102, vol. 3.

58. Both reports are located in NPCC project file B-2. DHH, 79/246, box 10, file 82.

59. "The Suitability of the HSS-2 as an Alternate Choice of Helicopter for ASW Operations from Destroyer Escorts," 27 October 1961, DHH, 79/246, box 10, file 82.

60. Memo to MND from D/MND, dated 27 December 1961, DHH, 79/246, box 10, file 82.

61. Letter from Sec TB to D/MND, 16 January 62 (TB 590367) and reply memo from D/MND to CNS, 17 January 1962, NPCC project file B-2. DHH, 79/246, box 10, file 82.

62. Cafferky, 293–95.

63. Minutes of meeting to discuss the equipment requirements in the initial procurement of HSS-2 helicopters, on 17 September 1962, LAC, RG 24, acc. 1983-84/167, box 3428, file 7820-102-6, vol. 1; and letter from the Minister of Finance to the Minister of National Defence, dated 9 October 1962, LAC, RG 24, acc. 1983-84/167, box 3428, file 7820-102-6, vol. 1.

64. Letter from the Minister of Finance to the Minister of National Defence, dated 9 October 1962, LAC, RG 24, acc. 1983-84/167, box 3428, file 7820-102-6, vol. 1.

65. See D. W. Middlemiss and J. J. Sokolsky, *Canadian Defence: Decisions and Determinants* (Toronto: Harcourt Brace Jovanovich, 1989); and Michael Hennessy, "The Rise and Fall of a Canadian Maritime Policy, 1939–1965: A Study of Industry, Navalism and the State" (PhD diss., University of New Brunswick, 1995).

66. Lieutenant A. M. Percy, "Aircraft Facilities in DDE Conversions," n.d. DHH, 93/110, box 5, item 061.

67. Ibid.

68. Charlton and Whitby, 117.

69. Report of Proceedings for January 1965, HS 50, LAC, RG 24, 1983-84/167, box 721, file 1926-219/50. Canadian preparations and participation in this annual exercise were called MAPLE SPRING.

70. See Chapter 15 of Charlton.

71. AHR for 1966–67, HMCS ANNAPOLIS, 13 March 1968, DHH, 1277; message from CANMARCOM, DTG 280306Z June 1966, DHH, 81/520/8000, box 71, file 2; and Message from VX 10 to CANFORCEHED, DTG 262032Z January 1967, DHH, 81/520/8000, box 71, file 2.

72. Message from CANMARCOM, DTG 280306Z June 1966, DHH, 81/520/8000, box 71, file 2.

73. According to *Certified Serviceable*, NIPIGON's system had received its CSU in November 1966, yet VX 10 did not begin acceptance trials of NIPIGON's HHRSD until 6 December 1966 according to the VX 10 report by Lieutenant Commander Heath. DHH, 2000/15, box 6, file 102104. It is probable that the November 1966 CSU was for a dockyard retrofit of the system, and the "production" version was not installed and certified until the later date.

74. "Draft Project Management Charter for Completion of Aviation Facilities in DDH 205 and 265 Classes," n.d., DHH, 2010/1, file 11900 DDH-01, vol. 2. The full certification for day and night all-weather operations—Stage 2 CSU for instrument flight rules (IFR)—had to wait for a number of other factors including the fitting of a suitable stabilized horizon reference, upgraded communications, flight deck lighting, tactical air navigation (TACAN) and suitable approach radar. Minutes of Meeting on DDH 205 and 265 Class Ships Aviation Facilities, 12 November 1970, DHH, 2010/1, file 11900 DDH-01, vol. 2. See also memo and notes from the Technical Coordinator DDH Aviation Facilities to Director General Maritime Systems (DGMS), 30 January 1968, DHH, 2010/1, file 11900 DDH-01, vol. 2.

75. AHR for 1966–67, HMCS ANNAPOLIS, 13 March 1968, DHH, 1277.

76. Jean Véronneau, "The First Helicopter Air Detachment (Annapolis) from 4 April to 28 November 1967," *Warrior* (Spring 2010). Stuart E. Soward also makes this claim in, *Hands to Flying Stations*, vol. 2, 394–95; and Marc Milner accepts Soward's claim in *Canada's Navy*, 259.

77. Ship's Log for May 1967, HMCS ANNAPOLIS, 26 May 1967, LAC, RG 24, vol. 5488.

78. See George Huson, "A History of the Helicopter Hauldown and Rapid-Securing Device," *Maritime Engineering Journal* (September 1985); and Commander R. A. Douglas, "Helicopter/Ship Interface: Canadian Experience of Helicopter Hauldown and Rapid Securing Device" (paper, Commonwealth Engineer Officers' Conference, Bath, 15–16 September 1977), 213–20, DHH, 93/110, item 082.

79. AHR 1967, HS 50 (423 Sqn), DHH, 1312.

80. Ibid. MATCHMAKER was the code name for the multinational NATO ASW squadron that would eventually become known as the Standing Naval Force, Atlantic or STANAVFORLANT. SAGUENAY's HELAIRDET is correctly identified as the first operational one in both AHR 1967, HMCS SAGUENAY, DHH, 1293 and Patrick Martin and Leo Pettipas, *Royal Canadian Navy Aircraft Finish and Markings, 1944–1968* (Martin Slides, 2007), 145, 246.

81. AHR 1967, HS 50 (423 Sqn), DHH, 1312; and AHR 1967, HMCS SAGUENAY, DHH, 1293.

82. Ship's Logs for January–April 1967, HMCS NIPIGON, LAC, RG 24, vol. 5470.

83. Wilf Lund, interview with Vice-Admiral Dan Mainguy, 18 April 2001, DHH, 2001/30, file 1.11, (Protected B); and Ship's Log, HMCS ANNAPOLIS, 15 May 1967, LAC, RG 24, vol. 5488.

84. AHR 1967, HS 50 (423 Sqn), DHH, 1312; AHR 1967, HMCS SAGUENAY, DHH, 1293; and Ship's Log for May 1967, HMCS ANNAPOLIS, LAC, RG 24, vol. 5488.

85. AHR 1967, HS 50 (423 Sqn), DHH, 1312.

86. Ship's Log for May 1967, HMCS ANNAPOLIS, LAC, RG 24, vol. 5488; and Ship's Log for May 1967, HMCS SAGUENAY, LAC, RG 24, series D-12, vol. 5481.

87. Véronneau, 63; and the "Guide to DDH/Helicopter Operating Procedures," January 1968, which can be found at DHH, 2000/15, box 8, file 105396.

88. This was first done during the annual Canada–US MAPLE SPRING exercises off Puerto Rico in 1969. Memo from DGMS to Director General, Engineering DG ENG, 21 January 1969, DHH, 2010/1, file 11900 DDH-01, vol. 2. The complete report of Phase I of VX 10 Project Directive 132 is unclassified and held by Defence Research Development Canada (DRDC).

89. Without a visual reference to the horizon, the only thing the pilot could see in reduced visibility or at night was the moving ship beneath him. The resulting disorientation caused vertigo, which many pilots encountered because of the ship's motion relative to the aircraft. Put simply, what the pilot's body was feeling in terms of his balance and motion did not relate to what his eyes were seeing in terms of the pitching and rolling of the deck and hanger beneath him; therefore, his sense of balance was thrown off and this led to severe discomfort. Former test pilot Lieutenant-Colonel Glenn Cook (Retired) to author.

90. The author would like to acknowledge the material and experiences offered by former pilots, Glenn Cook and Bob Murray, who related information over many conversations on Tuesdays at the Canada

Aviation and Space Museum in Ottawa where they work diligently at piecing together Canada's military aviation legacy.

91. Plamondon, 72.

92. See Peter T. Haydon, *The Cuban Missile Crisis: Canadian Involvement Reconsidered* (Toronto: Canadian Institute of Strategic Studies, 1993); and Mayne, 154.

93. Memo from VCNS to CNS and others, 23 October 1956, attached to NB, 508-9, 24 October 1956, DHH, 81/520/1000-100/2, box 25, file 1.

94. Report of Proceedings for March 1965, HMCS BONAVENTURE, DHH, 81/520/8000, box 11, folder 2.

95. Report on Helicopter Operations in HMCS ANNAPOLIS, January–August 1966, LAC, acc. 94-0831, box 36, file 11900 DDH 265-01.

96. Mayne, 146.

Operation BRIDGE:
A Bold Leap Towards the Cyclone

> The recognition that things that are not sustainable will eventually come to an end does not give us much of a guide to whether the transition will be calm or exciting.[1]
>
> Timothy Geithner

By Colonel Sam Michaud, OMM, M.S.M., CD (Retired)

By 2008, the maritime helicopter (MH) community in 12 Wing[2] was still very much trying to reset itself following the herculean efforts of Operation (Op) APOLLO, which saw the MH community deploy its helicopter air detachments (HELAIRDETs) repeatedly for long back-to-back deployments in the months following 9/11. This tremendous surge effort, an essential part of Canada's contribution to the global war on terrorism, resulted in a dip in flying rates and a resultant reduction in the rates of aircrew and technician force generation (FG) in the wake of the deployments. The community hit its nadir in February 2006 when the loss of Sea King CH12438 placed a spotlight on the residual, deleterious effects of the low flying rates on pilot proficiency and community morale.

At the same time, the broader Air Force was facing the demographic effects of the force reduction programmes (FRP)[3] of the 1990s, which had seriously reduced the cadre of experienced aircrew and technicians available to line units as operational tempos remained at record high rates. Set against a tableau of rapid fleet renewals and large

investments across the Air Force, there was a clear imperative to focus intensely on the FG of new personnel to maintain operational capacity and to be ready to introduce new aircraft as they arrived in service.

The challenge of introducing a new aircraft into service in the MH community was seen to be greatly exacerbated by the multigenerational leap in technology that the CH148 Cyclone would represent in relation to the Sea King. While the Sea King continued to provide yeoman service—thanks in large part to the often heroic efforts of its technicians and support personnel—the clear reality was that it was functionally obsolete for any modern maritime warfare tasks. As well, the lack of technology investment in the past decade meant that the Sea King's avionics simply did not provide a sufficiently advanced platform to prepare crews for the demands of a 21st-century weapon platform. Remembering that the Sea King entered service at the same time as the CF104 Starfighter, the jump from Sea King to Cyclone would be analogous to a jump from the Starfighter to the F-35 Joint Strike Fighter—without the benefit of the CF188 Hornet as an intermediary.

While the efforts of the community in implementing Project Transform[4] were yielding tangible improvements to aircraft availability and flying rates, it was obvious that a change of vector would be needed if the community was to be ready for the arrival of the Cyclone while also meeting the operational demands of the day. Given this stark outlook, the Wing Commander, Colonel Bruce Ploughman, signed an initiating directive in June 2008 to begin work on what would become known as Op BRIDGE. The directive set in motion work to develop a plan that would position the MH community to support the overall Air Force pilot production goals, maintain (or develop) relevant transitional operational capability and capacity in the CH124, and set the conditions for rapid transition to the CH148.[5]

A planning team was assembled; its members were drawn from all units in 12 Wing and placed under the leadership of the Wing Chief of Staff, Lieutenant-Colonel Jeff Tasseron. The team was given several months to address the challenge and tasked to fulfill five key goals:[6]

- optimize 12 Wing FG capacity to increase the overall generation and absorption of MH pilots[7] by a minimum of 50 per cent by reducing or eliminating all non-value added demands that limit or constrain Sea King FG;
- define a "twilight" concept of operations (CONOPS) to align Sea King capabilities to meet known and emergent operational demands through the development of key new capabilities that will optimize the Sea King's utility as an intelligence, surveillance and reconnaissance (ISR) platform and the temporary de-emphasis of extant low-probability, high-demand tasks such as antisubmarine warfare (ASW);
- optimize Sea King aircrew training and currency requirements to meet the immediate force employment needs established by higher headquarters, and implied by the twilight CONOPS, while accepting risk in areas that have been identified for de-emphasis through the bridging period while ensuring that core MH skill sets are preserved;
- increase Sea King yearly flying rate (YFR) production, as required, to meet the demands of the plan; and
- maintain core MH skill sets and competencies.[8]

One of the early difficulties encountered in the analysis was the development of a transitional—or twilight—CONOPS for the Sea King that would define a meaningful end-of-life role for the Sea King that was realistic, attainable and useful. The tension

that emerged resulted less from a lack of resources than it did from a debate over how much of the Sea King's traditional ASW role could be depreciated to offset investments into other non-traditional mission areas. The debate was not, as some might expect, a Manichaean black and white disagreement between the traditionalists who saw ASW as sacrosanct and the post-cold-war reformists who believed that ASW was no longer relevant in a post-9/11 world. Indeed, there was broad agreement that—irrespective of one's views on the relevance or likelihood of the ASW fight in the new world order—the Sea King's mission systems were simply no longer combat effective for the demands of a modern ASW war. The real debate centred on whether it was necessary to maintain the ASW mission set as a high-demand mission set to act as a crucible that would gel MH crews into the highly effective, and mission-flexible, crews that had carried the community so far.

Following lengthy debate and analysis, it was accepted that there was a very real need to maintain the ability to train MH crews to operate in high-demand, dynamic and information-rich mission sets. When set across the foreseen operational demands of the coming years, it became obvious that something other than traditional ASW needed to be developed to provide this training while also being more relevant to the pressing operational challenges facing the community. The debate also generated one of the most powerful insights of the Op BRIDGE analysis: the understanding that the Sea King itself would be the most important transitional tool available to prepare the community for the Cyclone. Therefore, as an adjunct to the immediate operational needs, the new mission focus had to be carefully conceived to better prepare crews for the highly integrated, sensor-rich, mission systems coming in the Cyclone.

In considering the option space available for a new twilight focus, the mission analysis first had to consider the full spectrum of missions that could be assigned to a generic MH platform and then focus in on what was core to the MH community and what was relevant to the demands and imperatives of the coming years—not least of which were the expectations of the Canadian Government as articulated in the release of the *Canada First* Defence Strategy (*CFDS*).[9] The broad results of this analysis are shown in Figure 1, which graphically represents a subtle but significant shift away from high-readiness ASW operations towards an ISR mission set that was in greater demand for ongoing real-world missions and operations like Op PODIUM—the 2010 Vancouver Winter Olympics—that were on the immediate horizon. In practice, this approach did not advocate for a complete abandonment of ASW training, nor did it imply that ASW was no longer relevant, it merely argued for a more sensible balance of priorities given the realities of the day—a shift towards General Hillier's metaphorical "ball of snakes" and away from "the bear."[10]

The mission analysis also brought clarity to what would be defined as the critical MH core—those capabilities without which the community would no longer be seen as a credible MH capability. It was agreed that, once defined, the core would

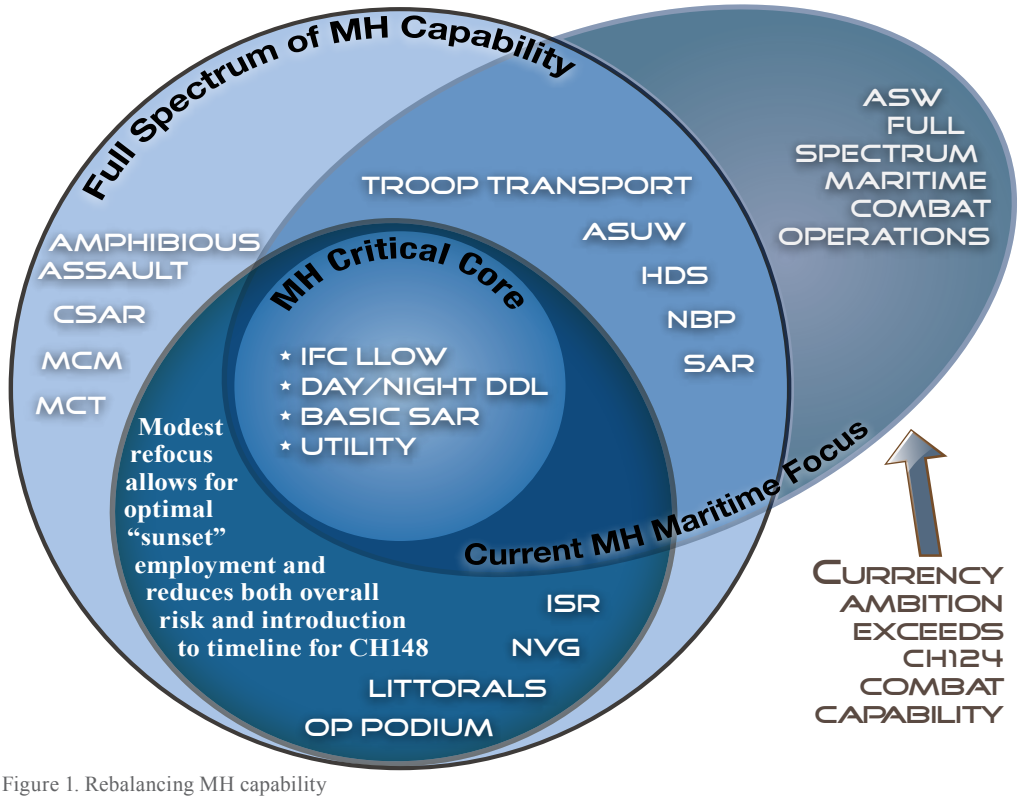


Figure 1. Rebalancing MH capability

represent the vital ground of the community's competencies that would be defended from all resource pressures or externally imposed expediencies. While the core capabilities were deliberately constrained to what appears to be a superficially simple list, the core concept was a powerful tool in defending the community's critical competencies when faced with external pressures to adopt simple solutions to complex problems. This was evident in the later fight to sustain core sea time when operational demands for overland mission sets peaked during Ops PODIUM and CADENCE.[11] As finally defined in the Op BRIDGE order, the MH core mission set was defined as the ability to:

- operate day or night in either visual or instrument meteorological conditions (VMC or IMC) embarked upon HMC [Her Majesty's Canadian] Ships or in the overland littoral environment;
- operate day or night in either VMC or IMC in the low level over water (LLOW) environment, including transition to the coupled hover;
- manage operational duties and perform on-board sensor fusion in the dynamic small crew context;
- perform basic utility and logistical support, including slinging and hosting, either embarked or ashore; and
- perform basic organic SAR [search and rescue] functions, either embarked or ashore.[12]

By the end of the summer of 2008 and with the key debates largely resolved, a draft plan and decision brief were ready for final Wing Commander approval and sign off. Despite the intensity and passion of some of

the earlier debates, by the time of the final decision brief, a strong, pervasive consensus had been achieved among the core 12 Wing command staff, and there was unanimous acceptance of the three key driving factors identified in BRIDGE that made immediate action imperative:

- the need to dramatically increase the force generation (FG) of aircrew and technical and support personnel to address the looming demographic hole, and to meet the challenge of rapid fleet renewal across the air force;
- the imperative to meet operational force employment (FE) demands in an adaptable and evolving operating environment … in the final years of the CH124 Sea King's operational life; and
- the requirement to transition quickly and effectively to the new CH148 Cyclone when it arrives.[13]

It is important to note that the earlier pilot centricity of the Operation BRIDGE initiating directive had given way under the weight of the analysis that showed that a complex balance of personnel FG was necessary to sustain a meaningful deployable capability. This nuanced understanding of a complex problem space later led to important decisions—like the decision to remove an airworthy Sea King from flight operations to dedicate the airframe for technician force generation—that would not have been manifestly evident if the focus had remained on pilot FG. Indeed, in the face of unrelenting pressure from the Air Force senior leadership to focus solely on pilot training, the Op BRIDGE analysis gave the MH leadership the understanding of the importance of ensuring equal care and attention was given to all MH FG efforts to achieve an effective and sustainable operational output.[14]

Op BRIDGE focussed the wing's efforts along four main thrust lines: purpose, people, plane and processes. Within each of the thrust lines, a set of defined activities and measurable goals were directed. While delving into the specifics of each task and goal is beyond the scope of this paper, the key parts of each thrust are described below:

A. Purpose. For much of its operational history, the MH community has defined itself based on the needs and operational imperatives of general maritime warfare. However, as the [Sea King] operational mission suite has drifted into obsolescence, [the ability of the Sea King] to contribute meaningfully in the high-end arena of ASW has diminished at the same time as the probability of our participation in such roles has lessened. As well, there has been a growing understanding that the most valuable knowledge transfer between the [Sea King] and the [Cyclone] is not in the realm of traditional operational capabilities[15] but rather in the operational skill sets that comprise core MH competencies. Therefore, while still operating with the defined boundaries of the approved MH CONOPS,[16] … the MH community will focus on a "Twilight" CONOPS for the [Sea King] that is broadly defined by a decreased focus on high-cost, low-demand capabilities to enable a shift towards the low-cost, high-demand, high-impact capabilities that characterize our contemporary operational environment.[17]

B. People. To build and sustain a "qualitatively superior and quantitatively sufficient cadre of operationally focussed aircrew, technical, and support personnel,"[18] the MH community would increase production of CH124 pilots

from 12 per year in 2008 to 16 per year in 2009 while maintaining a balance in the production of other aircrew and technical occupations. It was also directed that the outflow of MH technicians would be stabilized[19] "to permit the maintenance of a minimum of 80 percent POM (performance of maintenance) [qualified technicians] at the operational squadrons."[20]

C. Plane. Despite its advanced age and the obsolescence of many of its mission systems, the [Sea King] remains one of the most operationally employed combat platforms in the CF. … Success in its final years of service will be defined by not only the contribution of the CH124 to the operational success of the MH community but also by its effectiveness as a key transitional tool. [Among the primary initiatives directed in this thrust were the directives to]:

1. identify and remove high-maintenance, obsolete mission systems, including the AN/AQS-13 SONAR,[21] from the aircraft to enhance the sustainability of the CH124;

2. …

3. assess and recommend modest ISR mission capability enhancements[22] which are relatively low-cost, low-risk, and high return-on-investment …; and

4. introduce a night vision goggle (NVG) capability[23] to reduce operational risk … and to accelerate CH148 transition.[24]

D. Processes. Intended to build upon the initiatives and lessons of Project Transform, BRIDGE directed the implementation of a series of initiatives best described as a continuous improvement effort designed to shift the culture of the community irrevocably into a lean and innovative mindset similar to the one that had defined the early years of the community.

The initial reception to the release of Op BRIDGE was decidedly mixed and was largely due, in hindsight, to the failure of the wing's leadership to fully appreciate how disruptive the initiatives would be seen to be to entrenched interests. Some senior leaders jumped quickly to erroneous conclusions[25] about the intent of Op BRIDGE and accused the community of "going rogue" by redefining its mission without higher authorization to do so. In reality, this visceral reaction was mostly due to a lack of prebriefing the senior leadership of both the Air Force and Navy to ensure that the full intentions were clear and seen to be respecting approved lines of authority. Despite the initially turbulent reception from above, once the misconceptions had been addressed and the wing leadership chastised for stepping out too far in front of its mandate, the general impression received back from informal feedback appeared to be overwhelmingly positive. Not only was the need for immediate and transformative change recognized, the general approach of BRIDGE was seen to offer insights that could be useful to the challenges facing the broader Air Force. In particular, the need to review self-imposed regulations to see what inefficiencies could be removed was embraced by the operational leadership of the Air Force.

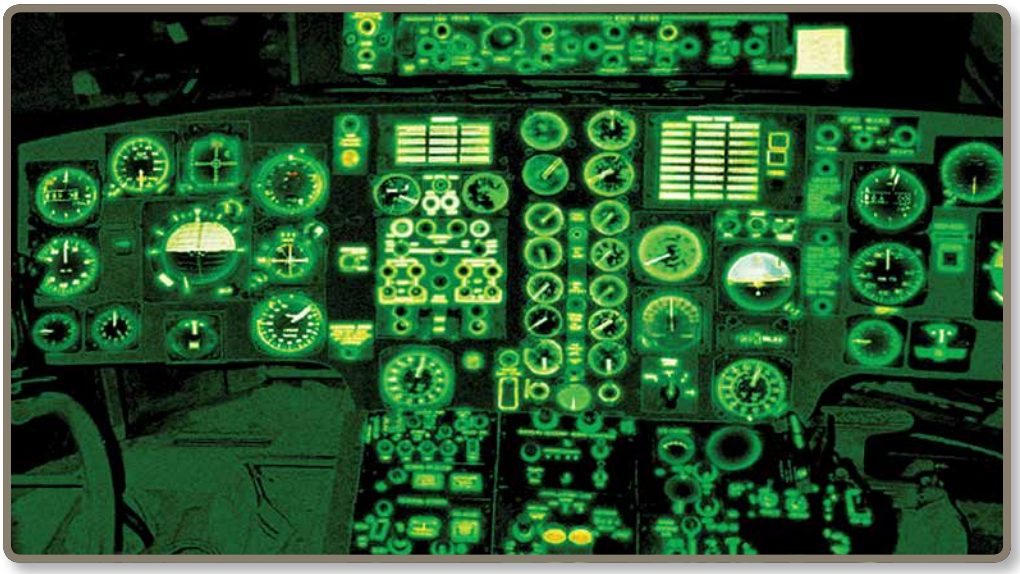
Within the MH community, the reception was far more positive, largely due to the broad engagement early on in the analysis and a more visceral understanding of the immediate challenges facing the wing. While not everyone agreed with every element of the direction, the broad thrusts were easily

accepted, and the clear, specific nature of the direction contained in the operation order left little doubt as to what was expected. Certainly, many saw the directive as both an opportunity to push for reform and a call to arms to implement innovative solutions. Nowhere was this latter enthusiasm more evident than in the Augmented Surface Picture (ASP) initiative spearheaded by a small team led by Majors Dwight Bazinet and Josiah Goodyear, plus Captain Kel Jeffries.

The ASP story has been well documented elsewhere, so it is not this paper's intent to revisit this story of stunning technical innovation, grass-roots leadership and personal perseverance. What is important in this context is to understand that the conditions required for ASP to move forward with unequivocal leadership support and endorsement were forged in the Op BRIDGE directive. It was the understanding that the MH community needed to shift away from its traditional focus on general maritime warfare and focus instead on the "low-cost, high-demand, high-impact capabilities that characterize our contemporary operational environment."[26] This core shift in purpose—which underpinned the general philosophy of Op BRIDGE and led to the specific direction under the third thrust line (Plane) to investigate "modest ISR mission capability enhancements which are relatively low-cost, low-risk, and high return-on-investment"[27]—was the direct organizational genesis for ASP. Given the commitment of the ASP core team, the assistance of supporting agencies and the supporting context provided by BRIDGE, it is still impressive to note that the team achieved first flight on a brand-new integrated ISR mission system in October 2009, barely a year after the signing of the Op BRIDGE operation order. ASP remains one of the most tangible and lasting successes that resulted from BRIDGE and, at the time of this writing, is in high operational demand in the fleet and continues to benefit from ongoing development.

An equally important capability investment was the introduction of NVGs to the Sea King. While NVGs had first been flown on the Sea King in the early 1990s as part of Op FRICTION (the Canadian contribution to the first Gulf War), the lack of an NVG-compatible cockpit meant the use of NVGs was limited to back-end crew. This effectively left the pilots flying "blind" at night and reliant solely on the flight instruments to keep the aircraft out of danger. Adding the capability to the Sea King was not as simple as strapping goggles to the pilots' helmets—indeed, the undertaking was complex enough that previous efforts had repeatedly fallen short. The reasons that the previous initiatives had failed are complex, but one of the key missing pieces was always the lack of a clear reasoning for the initiative to give it the foundation necessary to overcome institutional inertia. After all, the Sea King had operated just fine for over four decades without NVGs, so many questioned the need to make the investment with the Sea King's retirement "imminent."[28]

Op BRIDGE provided the needed foundation by offering two key reasons to answer the question "why now?" and to provide the logic that explained the value of the return on invested capital. First, the mission sets that were increasingly becoming part of the Sea King's routine tasks involved more and more overland flying. Without NVGs in the overland environment, the aircraft's mission effectiveness became extremely limited at night, as it was almost impossible to operate safely in the low-level flight environment when the pilots could not see and avoid obstacles. The second reason



was that the Sea King provided the perfect introductory vehicle for NVG training in advance of the Cyclone. Rather than have pilots grapple with the tasks associated with flying and fighting a brand new aircraft while also developing the procedures to operate in the MH environment, it was seen as prudent to "pull forward" the requirement to learn and develop these skills in a familiar aircraft. Doing so would not only reduce the overall risk of the training but also reduce the transition time to the Cyclone when it arrived.

The project to convert the Sea King fleet to be fully NVG compatible was an enormous success. A prototype configuration was designed, installed and tested in rapid order thanks to a cooperative effort from units across the CF. The clear prioritization of the effort by Air Force leadership and the lack of equivocation from the MH community on the importance of the capability were key drivers to the rapid implementation and flowed naturally from the vision established in the Op BRIDGE directive. By early 2011, training of operational pilots had begun in earnest, and the success of the project could be measured by the extreme reluctance of NVG-qualified pilots to fly at night without goggles[29] once they had flown with them. At the time of writing, the conversion of the MH community to NVGs had been successfully completed without significant incident.

As time passes since the initiation of Op BRIDGE, the vision it laid out remains a powerful influence in the MH community, even as its very name slowly fades into disuse. While two of the most visible and obvious projects that derived from BRIDGE have been used here to highlight the potency of its powerful vision and clear direction, the changes in the MH community stemming from BRIDGE have been legion. Indeed, while it is still too early to definitively declare Op BRIDGE a success, the most significant and lasting effects will likely be found in the cultural shift that it enabled more so than the physical artefacts introduced through a series of connected initiatives. The final word on BRIDGE will be written[30] after the Cyclone has been successfully introduced to service and the Sea King paid off from military employment. But what can be declared without hesitation is that the MH community is far better positioned to face the concatenated challenges of operating in the messy milieu of today's contemporary operating environment and making the multigenerational technological leap into the Cyclone when it is finally ready to fill the Sea King's shoes.

Colonel Sam Michaud (Retired) joined the Canadian Forces in June 1986 as a Primary Reserve infantry soldier with the West Nova Scotia Regiment. He transferred to the Regular Force in December 1987 to begin training as an officer and a pilot. Upon completion of training, he was posted to Shearwater, Nova Scotia, to complete conversion training on the CH124 Sea King. Through his career, Colonel Michaud served multiple tours on the Sea King as an operational pilot, instructor pilot, standards officer, detachment commander as well as enduring three tours in National Defence Headquarters where he served as a staff officer in various positions related to joint force development. Colonel Michaud's career highlights include deployments to the first Gulf War and Somalia as well as command of 423 Squadron and 12 Wing Shearwater. He retired from the Canadian Forces in February 2013 to pursue a second career in the defence industry.

Abbreviations

9/11	11 September 2001
ASP	Augmented Surface Picture
ASuW	antisurface warfare
ASW	antisubmarine warfare
CF	Canadian Forces
CFDS	*Canada First* Defence Strategy
CONOPS	concept of operations
CSAR	combat search and rescue
DDL	destroyer deck landing
FG	force generation
FRP	force reduction programme
HDS	helicopter delivery service
HELAIRDET	helicopter air detachment
IFC	instrument flight conditions
IMC	instrument meteorological conditions
ISR	intelligence, surveillance and reconnaissance
LLOW	low level over water
MCM	mine counter measures
MCT	mobile command team
MH	maritime helicopter
NBP	naval boarding party
NVG	night vision goggle
Op	operation
SAR	search and rescue
VMC	visual meteorological conditions
YFR	yearly flying rate

Notes

1. Timothy Geithner, BrainyQuote.com, http://www.brainyquote.com/quotes/quotes/t/timothygei409306.html (accessed June 18, 2013).

2. 12 Wing is the operational formation responsible for all MH operations in Canada and has units located in Shearwater, Nova Scotia, and Patricia Bay, British Columbia. At the time of the article's writing there remained 27 of the original 41 Sea Kings in operational service with the majority of them based on the East Coast in Shearwater.

3. The FRPs of 1992 and 1993–96 saw almost 14,000 Regular Force Canadian Forces (CF) personnel take early retirement as part of a series of initiatives to reduce the size of the CF at the end of the cold war. For more information see Chief of Review Services Director General Audit, 7055-29 (DGA), January 1997, Audit of Force Reduction Program.

4. Project Transform, an Air Force-wide initiative, was implemented at 12 Wing in 2003; its aim was to develop long-term options for viable and sustainable capabilities for each Air Force fleet / warfare community. In the context of the Sea King fleet, this initiative was complicated by a number of issues, including inadequate manning, budget cuts, reduced yearly flying rate (YFR), rising fuel costs and a continued high operational tempo. 12 Wing had a flat organization structure with an inadequate wing staff structure and was, therefore, unable to actively manage the above issues. In very broad terms, Project Transform highlighted the need for

a robust FG capability (aircrew and technicians) that effectively balanced force employment and FG demands. The plan produced by 12 Wing was well-received by the Air Force, who saw the wing embrace the tenets of Project Transform. The indelible impression left by 12 Wing was one of proactive management and taking charge of their destiny "within means and capabilities." The unforeseen benefit of this shift in higher headquarters perspective was that future 12 Wing requests for support were better received within the Air Force. Project Transform eventually started to bear out the predicted increases in YFR and, by extension, aircrew FG, thereby setting the conditions for Op BRIDGE.

5. 3000-1 (W Comd), 23 September 2008, 12 Wing Operation Order 010/08 Operation BRIDGE – 12 Wing Transition, paragraph 1.

6. Ibid., paragraph 6

7. The intent of Op BRIDGE was not to be pilot centric, but the implicit assumption was the pilot FG was the "long pole" in the FG tent and any success in reducing impediments to pilot FG would be reflected in improvements throughout the wing's FG process. In practice, it became evident that this was a good starting point for analysis but was insufficient to address all challenges particularly when it came to technician FG and the need to think more broadly was accepted by the time Op BRIDGE was ordered into implementation.

8. What constituted "core MH skill sets and competencies" had never been defined and became one of the implied tasks of Op BRIDGE. An earlier attempt in 1994 to define a core and modular approach to currency and readiness had failed to achieve consensus and was never implemented. In the Op BRIDGE analysis, achieving consensus on the core took many months of discussion and was ultimately resolved at the 12 Wing command level through round-table discussion with the senior leadership of the wing.

9. The *CFDS* was a combined defence policy statement and procurement plan announced by Prime Minister Harper in May 2008. Initially released simply as a declaration, it was eventually formalized into a document that expanded on the principles announced by the Prime Minister. The *CFDS* is available at http://www.forces.gc.ca/site/pri/first-premier/index-eng.asp?WT.svl=CFDLEFT (accessed on June 18, 2013).

10. General Hillier, "Setting Our Course" (speech, CISS Seminar: Implementing Canada's Defence Policy Statement, Royal Canadian Military Institute, July 22, 2005) as cited in Philip S. E. Farrell "Control Theory Perspective of Effects-Based Thinking and Operations: Modelling 'Operations' as a Feedback Control System," Technical Report 2007-168 (Ottawa: Defence R&D Canada, November 2007) http://cradpdf.drdc-rddc.gc.ca/PDFS/unc95/p528512_A1b.pdf (accessed June 18, 2013).

11. Op CADENCE was the 2010 CF mission to provide security for the G8 and G20 summits being held in Ontario.

12. 3000-1 (W Comd), 23 September 2008, 12 Wing Operation Order 010/08 Operation BRIDGE – 12 Wing Transition, paragraph 6 f.

13. Ibid., paragraph 1.

14. Ibid., paragraph 2.

15. As the mission suite of the Cyclone took form, there was a growing understanding that the new sensor suite brought with it such a quantum leap in capability that traditional tactics and approaches to ASW being used in the Sea King would have little or no relevance in the Cyclone. Therefore, it was the general thinking, problem solving and crew coordination skills that were most valuable to the transfer, not the specific application of tactics.

16. 1 CAD HQ 3255-4 (A3 MH RDNS), 20 March 2001, CH124 Sea King Concept of Operations, (note that the last approval of the Sea King CONOPS predates the historic events of 9/11).

17. 3000-1 (W Comd), 23 September 2008, 12 Wing Operation Order 010/08 Operation BRIDGE – 12 Wing Transition, paragraph 7 a. This subparagraph is seminal to the understanding of the core pivot articulated in the Operation BRIDGE operation order.

18. Ibid., paragraph 7 b.

19. In retrospect, it was naive to expect that the MH community would have authority over or would be able to influence the posting priorities for 500-series technicians when other, more influential, communities were hemorrhaging experienced technicians to industry. But it is instructive to note the specific and measurable nature of the goal, a characteristic that defined the overall approach to Op BRIDGE.

20. Ibid., paragraph 7 b (4).

21. Ibid., paragraph 7 c (1). Note that the directive to remove the SONAR from the aircraft was not implemented due to higher headquarters direction to maintain at least the external perception that ASW continued to be strongly supported by the air force.

22. This direction became the initiating direction that led to the development of ASP—an innovative, home grown, integrated mission computer—described later in this paper.

23. Following decades of abortive attempts to introduce NVGs to the Sea King, this initiative was successful with the introduction to service beginning in 2010.

24. Ibid., paragraph 7 c.

25. It didn't help that the West Coast fleet was in the process of preparing a high-readiness ship to join an American task group for a series of ASW exercises and the Op BRIDGE directive was seen to be a direct challenge to their path to high readiness. It was only after a personal briefing by the Wing Commander to the West Coast leadership that tensions eased when it was clear that the wing was still committed to providing a high-readiness ASW HELAIRDET for the deployment. However, this incident put to rest any intention of removing the SONARs from the Sea King fleet to avoid triggering any further sensitivities.

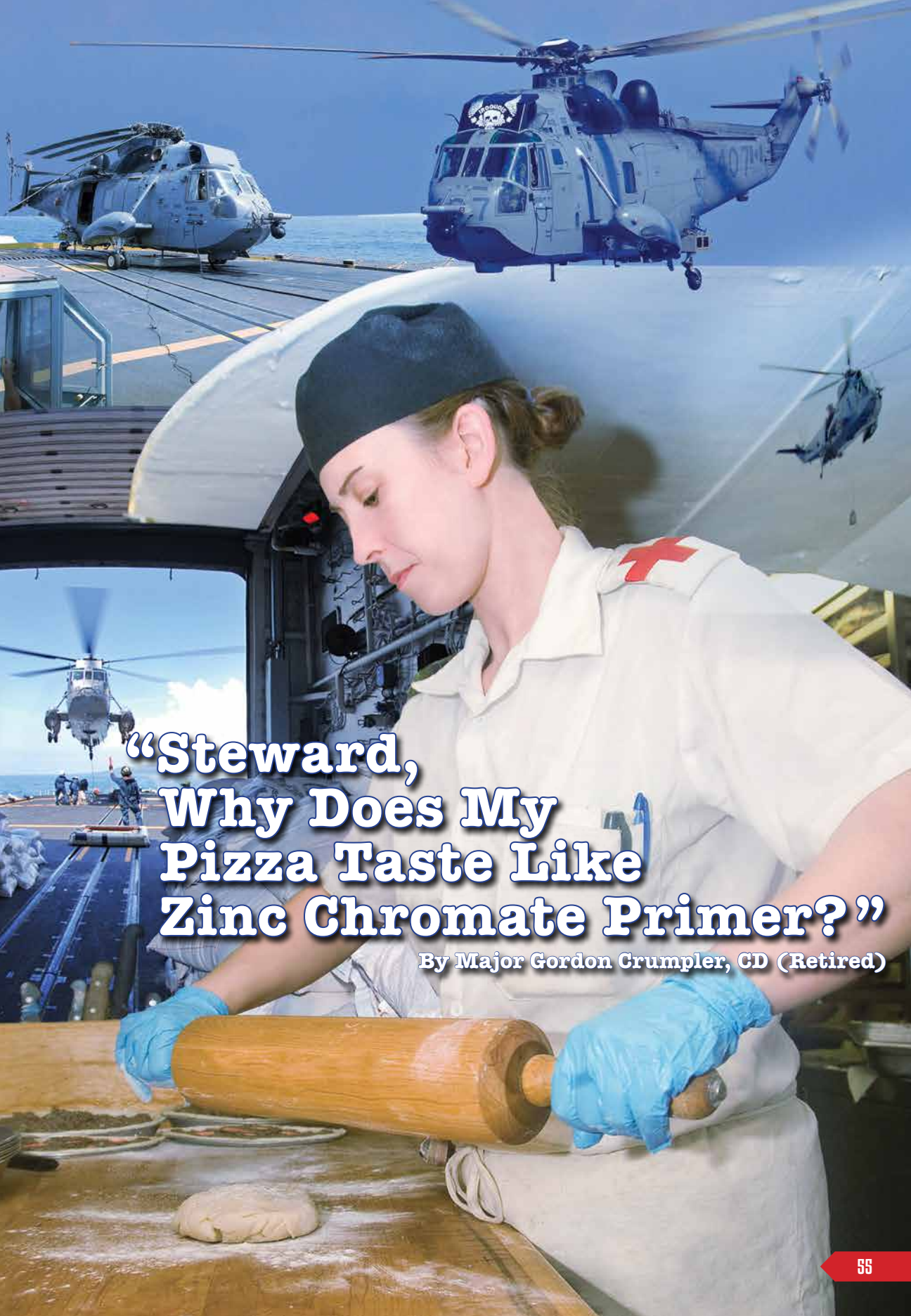
26. Ibid., paragraph 7 a.

27. Ibid., paragraph 7 c (3).

28. The "imminence" of the Sea King's retirement has long been a tired joke in the MH community. It has also been used as an excuse to avoid making substantial capability enhancements to the aircraft for almost two decades.

29. In the early days of NVG conversion training, it was sometimes necessary to task an NVG-qualified pilot to fly a mission with a non-NVG-qualified pilot. By explicit policy, if one pilot was not qualified on NVGs the crew had to default to the lowest common denominator and fly without NVGs. Flying a "mixed" cockpit, with pilots relying on widely different references, had proven to be a dangerous combination in other communities, and the MH community elected to implement this lesson learned from others.

30. The "end-state" defined in the Op BRIDGE order is said to occur "with the successful phase-out of the CH124 and the achievement of an initial operational capability with the CH148." Ibid., paragraph 8.



"Steward, Why Does My Pizza Taste Like Zinc Chromate Primer?"

By Major Gordon Crumpler, CD (Retired)

If you served on Her Majesty's Canadian Ship (HMCS) PRESERVER during Exercise OCEAN SAFARI '79, you may have asked this question. It all started at noon on a sunny Saturday at sea, September 29, 1979, off Cape Wrath, Scotland (Latitude: North 50-0, Longitude: West 50-0). PRESERVER, IROQUOIS and ASSINIBOINE were conducting a vertical replenishment (VERTREP) during a pause in the exercise. In typical operations' fashion, the flight schedule had changed a half-dozen times that morning. IROQUOIS actually had time to conduct gunnery practice in between launches.

Despite the normal confusion of constant change, things were going pretty well. IROQUOIS and ASSINIBOINE were looking forward to fresh supplies of frozen meat and cold beer, and we on PRESERVER were looking forward to some different movies. We had almost settled into a predictable deck-cycle routine when it happened. Instead of hovering over the deck to drop its empty cargo net and pick up a full load, Sea King CH12416 made an unannounced free deck landing. No emergency had been declared, but the reason for the intrusion was immediately obvious. The cargo net, with an empty tri-wall box and wooden pallet in it, was wrapped around the aft port torpedo launcher. The high frequency (HF) antenna stanchion on the sponson had been torn off, and the antenna wire was tangled up with the cargo net and hooked around the tail wheel. On closer inspection, there was a sizeable hole and some dented skin down the lower left side of the tail cone.

CH12416 had taken off from IROQUOIS a few moments before with the empty tri-wall. As the aircraft picked up speed, the load began to trail. Then at 60 knots [111 kilometres per hour] indicated air speed (IAS), in a gentle left turn, the load developed excessive swing, struck the aircraft fuselage and then caught on the aft torpedo launcher. Fortunately, the aircraft was approaching the PRESERVER's stern. The pilot was unable to jettison the load but was able to land without further incident.

VERTREP for HMCS IROQUOIS

CF Photo: MCpl Charles Barber

PRESERVER had no choice but to declare the deck "fouled" until we could figure out what had happened and take the necessary steps to clear the deck while preserving the evidence for the inevitable flight safety investigation.

The external damage was limited to the broken HF antenna and damaged sponson where the stanchion attached and a large gouge and skin damage to the tail cone as mentioned earlier. It was sheer luck that the cargo net or antenna wire did not come in contact with the tail rotors. Inspection of the interior of the tail cone revealed that an internal section of frame had been practically sheered in two and that three adjacent stringers were badly damaged. The general reaction from the maintenance crew was that 416 would be "craned off" when we got back to Halifax on 3 November.

I now digress slightly to explain a time lapse in the 416 saga: On conclusion of the VERTREPS, all three ships proceeded into Loch Eriboll, Scotland, for safe anchorage and to continue the pause in the exercise. That evening, we had a splendid mess dinner in PRESERVER's Wardroom. After the toasts and speeches, the Executive Officer (XO) challenged the Air and Engineering departments to a wardroom hockey game against his Operations and Combat departments. He pulled rank and declared that we would play by his rules and that he would referee. The furniture was moved to one side, and we prepared for battle. Dress was mess kits with jackets, socks and shoes removed. Hockey sticks were brought up from sports stores and distributed to the players. The XO explained the rules. Players could only hold the stick with one hand; the other hand needed to hold your beer. Spilling beer would be a minor penalty. Full body contact was allowed and indeed expected, and players in a position to score needed to ask the XO for "permission to shoot." I can't remember how long the game lasted or the final score, but I'm sure our side prevailed. The notable statistic that remains with me is that Sub-Lieutenant Gerry Conrad delivered a massive body check to the Deck Officer, knocking him into the bar rail and out cold. After the game, a few of us victors gathered some musical instruments including bagpipes, a harmonica and a trumpet and proceeded to the Flag Deck to announce our victory to the Scottish countryside. Shortly into our musical celebration, a signal light was noticed coming from IROQUOIS (flagship of the Canadian Task Group [CTG] Commander) sending a message in Morse code, ordering us all to bed.

The next day was a Sunday routine at sea, so things were quiet, giving us all a chance to enjoy the magnificent scenery of the loch as we departed. The following day, I was approached by the Detachment Chief, Master Warrant Office Jerry Stillwell and Sergeant Tony Arcand. Arcand had been surveying the damage to 416 and believed it could be repaired on board if we had the right materials and could somehow heat treat the aluminum to the right temper. He convinced us that his naval air aviation technician (tech) training had included metal repairs which was normally the responsibility of metal techs in the Air Force. We had another five weeks of exercise and could really use another aircraft. PRESERVER's Captain (CO) and the CTG Commander were keen to get the aircraft back into service, so we agreed to give it a try. It was decided that Arcand would be relieved of regular maintenance duties to focus on the development and implementation of the repair and that I would support him with the engineering element.

A survey of available material revealed that we had enough to make splices for the ribs and some for the stringers and skin. For technical guidance, we had Canadian Forces Technical Order (CFTO) C-12-124-AOO/MB-001, which showed how to fabricate and install standard structural repairs. Arcand quickly lived up to his claim to be trained in metal repair. Following the CFTO examples for standard repairs, he set about making rib templates from cardboard which he used to make plywood patterns with the help of the ship's hull techs in their workshop. The patterns were used to form the aluminum sheet stock by hand to the shape of the rib. It took several tries before he was satisfied, but eventually, we had a formed doubler and nested insert to work with.

Next came the heat treatment to bring the temper up. One of the ship's hull techs had a machinist's handbook which supplemented the CFTO with heat treatment temperatures. To bring the temper up, the pieces had to be heated to 900 degrees Fahrenheit (°F) [482 °Celsius (C)] for seven minutes and then quenched. The next step was a precipitate hardening process which brought the temper to the required final state. This only required 250°F [121°C] but for 22 hours. The high temperature step was beyond our capability aboard ship, but we were due for a five-day port visit to the Norwegian naval base in Bergen, Norway, later in the week. There would be ovens in the dockyard workshops, so an emergency requirement (EMREQ) message was sent off immediately to the Canadian Military Attaché in Oslo to make the necessary arrangements.

The next step was to cut and drill out the damaged frame, stringers and skin sections so that the new pieces could be fitted and riveted in place. This is where we hit our first snag. The Air Department carried a 90° air drill on inventory, but it had not been used in recent memory. It was completely seized, and all attempts to disassemble and lubricate it failed. This drill would be needed for some of the tight areas of the rib flanges close to the skin. A request for a loaner drill to be available upon arrival in Bergen Naval Yards was hastily added to the EMREQ. In the meantime, Arcand and Master Corporal MacDonald, an Air Force volunteer (also known as "Buddha" for his

CF Photo: Cpl Shawn M. Kent

body shape), proceeded as best they could with the tools at hand.

We left the exercise and headed for Bergen Naval Yard on Tuesday October 2nd, a day earlier than scheduled due to an urgent mechanical problem with the ship. The steam turbine that drives the forced lubrication pump for the main shaft (propeller) had seized up, apparently from oil starvation resulting in shaft and bearing damage beyond the repair capability of the Engineering Department. With the main lubrication pump not working, the only thing keeping the main shaft lubricated was the electrical backup lubrication pump. If it failed, there would be another KOOTENAY disaster according to the stokers. Between us and Bergen was the blue force [our "opposing" force during the exercise]. The CO was not happy with having to pull out of the exercise but thought he would make the most of it. He set the ship's navigation lights up and turned on the radar to make us look like a merchant steamer. A pipe was made to inform the ship's company of the plan and many of us manned the upper decks after dark to watch as we sailed through blue force on the overnight transit. At one point, we were within hailing distance of one of the blue force frigates who apparently had not caught on to the ruse.

It was a beautiful sunny day on Thursday, October 4th, as we sailed up the fjord into the Norwegian naval yards at Bergen. The dockyard didn't look like much from the jetty, just a few sheds and buildings backing onto the steep slopes of the surrounding mountains. As soon as the brow was opened, I was introduced to our Norwegian liaison officer, a commander, who would escort me around the dockyard. We made arrangements to rent oven time in the dockyard workshops, and we set off on foot to deliver the work pieces. As we turned a corner, we came upon a large hangar-type door opening into the

CF Photo: Cpl Jeff Neron

side of the mountain. As I followed my escort through the entrance, I quickly realized there was much more to this dockyard than first met the eye. In fact, we had entered a huge man-made cavern built into the side of the mountain that seemed to go on for miles. Every kind of dockyard facility imaginable was in this complex, apparently built by the Germans in World War II. Eventually we stopped at one of the workshop bays and were greeted by the shop foreman. I had documented the required temperatures and process times to be followed, and the commander interpreted the details to the shop foreman, who took notes. The foreman studied the pieces and his notes for a moment before telling the commander that the finished pieces would be delivered to the ship the next morning by 0930 hours.

We then set off to find their tool crib to borrow suitable drills. By the time we arrived at the tool crib, it was noon and the tool crib custodian was taking a nap on a table just inside the crib area. No amount of persuasion from the commander would get the man off the table. I could not understand what was being said, but the body language made it pretty clear that the man was on his official lunch break and the union would back him up. The fact that a senior naval officer had made a direct order or request did not matter. Who knew dockyard "maties" are the same the world over? The very sheepish Norwegian commander apologized to me and said we needed to get back to the ship as he had other pressing matters.

To their credit, the workshops delivered the heat-treated pieces to the ship at 0930 the next day. The pieces looked to be in good condition with no noticeable warping. I had been given permission from the Supply Officer and XO to commandeer the wardroom galley oven for the precipitate hardening for the next 22 hours at 250˚F [121˚C]. The appropriate settings were made and the door and controls taped off. The next day, the pieces were removed, cooled and carefully inspected. All were declared "serviceable" and delivered to the hangar for installation. Unfortunately, I had to put up with a lot of wardroom whining for the rest of the deployment about the taste of the food and how everything had acquired a strange taste and odour similar to zinc chromate primer.

Now that we had repair parts, we had to find a 90˚ air drill and get the rest of the drilling completed before departing Bergen. As it turned out, the Royal Navy's (RN) Her Majesty's Ship (HMS) *Hermes* had been operating with blue force and was due into Bergen for a port visit later that day. We decided to use the dockyard tool crib as our last resort, and when the *Hermes* gangway opened at 1550 hours that afternoon, Stillwell, Arcand and myself presented ourselves in full dress (S-3s) to the *Hermes*' Officer of the Day and requested to see the Duty Air Officer. We were escorted to the Air Maintenance Spaces where we met our RN counterparts. The RN was very gracious and sent us on our way in due course with some lovely loaner drills and bellies full of English beer. Arcand and MacDonald worked steady for the next two days to complete all of the drilling and fitting in time for us to return the drills to HMS *Hermes* before we sailed.

And now a small diversion from the saga of 416. It was on the second day of the Bergen visit that a special inspection (SI) was received calling for the immediate inspection of all tail rotor blades (TRBs) of the embarked Sea Kings. National Defence Headquarters had determined that high time blades were at risk for corrosion damage in the honeycomb structure and could fail. Any blade with more than 2,000 hours time since new (TSN) was to be immediately removed from service. IROQUOIS, ASSINIBOINE and FRASER were alongside in downtown Bergen while PRESERVER was tied up at the naval yards on the outskirts of the city, so for convenience, a meeting of the air department maintenance chief warrant officers was convened on IROQUOIS. Each detachment (det) provided a listing of their TRB assets, shown in Table 1.

Ship	TRB Status
ASSINIBOINE	3 installed blades time expired (> 2,000 hours)
IROQUOIS (2 aircraft)	2 installed blades plus one spare time expired
FRASER	2 installed blades time expired
PRESERVER (2 aircraft)	5 installed blades plus 2 of 4 spares time expired
NIPIGON (by message)	Required 2 TRBs when joined in Rosyth, Scotland

Table 1. TRB status by ship

A plan was quickly put together to spread the serviceable assets equally among the dets such that each ship would have one set of blades with enough useable hours to support continued operations until we could be resupplied. The respective air departments quickly put the plan into motion to move the assets during the port visit so that maintenance test flights could be scheduled as soon as ships could come to Flying Stations after departing Bergen.

The lubrication pump repairs were finally completed on PRESERVER, and we sailed out of Bergen on Monday, October 8th just before midnight. There wasn't much flying for the next few days due to thick fog and restricted manoeuvring room going through the Skagerrak Straits as we headed for our next port, Stockholm, Sweden. The 416 repair crew was ordered to stand down and go ashore in Stockholm for some well-deserved respite.

After Stockholm, work continued on 416 to fit the rib sections and stringers in place. By the 17th, the skin patches were being installed, and by the 19th, the repaired area was ready to paint. Surprisingly, the only "aircraft quality" paint that could be found in the ship's stores was the old Royal Canadian Navy dark grey semi-gloss. This caused the repair to stand out like a sore thumb on top of the light green paint scheme on the rest of the aircraft and was the cause of some good-natured ribbing by the fish-heads [sailors]. The job looked beautiful to us, and even the Air Department personnel not directly involved in the repair took pride when the aircraft was test-flown

CF Photo: MCpl Charles Barber

"serviceable" on October 20th with a set of "extended" TRBs. Despite all of the effort expended on getting 416 back into service, it saw no more flying for the rest of the deployment. Port visits, bad weather and careful husbandry of the remaining TRB hours limited flight operations to the bare necessities. Nonetheless, the Air Department took great pride in launching both aircraft in the Halifax approaches for their return to Shearwater. No "crane-off" for this det.

Each step of the repair was carefully documented, and a complete report was submitted to the technical authority as part of the post-deployment report. No fault or shortcoming could be found with the repair design or installation, and to my knowledge, that repair is still in place today.

Gordon Crumpler joined the Royal Canadian Air Force in November 1966. He trained as a Radar Technician-Air and was posted to 4 Wing Germany in April 1968. His first posting to Shearwater was to 50 Helicopter Anti-Submarine Squadron in September 1970. Major Crumpler (Retired) first went to sea in November 1970 while wearing leading aircraftman (LAC) propellers; his last sea tour was as a major in 1988. He was selected for University Training Plan for Men (UTPM) in 1972 and, after completing his aerospace engineering (AERE) training, was posted back to Shearwater as a lieutenant in January 1978. When he retired in 1997, he was the weapon system manager for the CH124. Gordon is currently contracted to the Joint UAV Surveillance and Target Acquisition System Project Management Office at National Defence Headquarters.

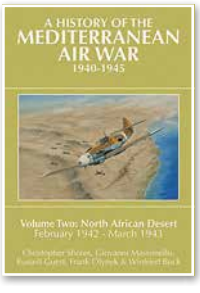
Abbreviations

°	degree
C	Celsius
CFTO	Canadian Forces Technical Order
CO	captain
CTG	Canadian task group
det	detachment
EMREQ	emergency request
F	Fahrenheit
HF	high frequency
HMS	Her Majesty's Ship
RN	Royal Navy
tech	technician
TRB	tail rotor blade
VERTREP	vertical replenishment
XO	executive officer

CF Photo: MCpl Eduardo Mora Pineda

BOOK REVIEWS

A HISTORY OF THE MEDITERRANEAN AIR WAR, 1940–1945, VOLUME ONE: NORTH AFRICA, JUNE 1940 – JANUARY 1942



By Christopher Shores and Giovanni Massimello with Russell Guest

Grub Street, 2012
560 pages
ISBN 978-1-908117-07-6

Review by **Major Chris Buckham, CD, MA**

With this book, the authors are revisiting some very comfortable ground stemming from Christopher Shores and Hans Ring's original work *Fighters over the Desert: The Air Battles in the Western Desert, June 1940 to December 1942* (1969) on the air war in the desert. Acknowledging that the passage of time has revealed errors of omission and has provided access to previously unavailable sources of information, they have decided that the time is right for a review. It should be stressed that this new book is not simply a rework of *Fighters over the Desert* but stands alone as a new look at air warfare in the desert.

Christopher Shores, Giovanni Massimello and Russell Guest approach their subject in two ways. With the commencement of each chapter they provide an overview of the strategic and operational activities impacting decision making and the execution of operations. Following this "situation of the estimate," they then provide a breakdown of the activities of the antagonists, identified by date. Significant events, losses and victories are all outlined in detail down to the serial number of the aircraft involved. The degree of detail is actually quite phenomenal with a synopsis box at the end of each write-up illustrating the axis/allies claims and losses.

This storyline would be quite dry if the authors had not added numerous first-person accounts of experiences (from all sides), thereby adding depth, breadth and a human face to the narrative. While these stories are fascinating and enlightening, the strength of this book remains its incredible

depth and scope of detail. For a researcher, the book provides commendable insight into the nomenclature and development of the air forces of the desert. It is fascinating to see the degree of complexity in the command and control as well as the structure of the Royal Air Force, Luftwaffe and Italian air force. Each chapter is predicated by an explanation of the changes that occurred within each of the services as well as a graphical representation of units and available aircraft.

Additionally, the authors provide regional context through the inclusion of discussion relating to critical theatre-level challenges. I refer in this case to the impact of the Island of Malta on the desert war. In their discussion of regional issues, the authors spend a significant amount of time outlining the conflict centring upon Malta and the efforts of the Axis to crush Allied capability through air power and the concurrent efforts by Allied surface and air units to strangle the Axis logistics support in the Mediterranean. Shores, Massimello and Guest also look at the efforts that the Allies had to expend to deal with Vichy French and Italian forces in the "rear" areas of Ethiopia, Iraq and Syria.

The authors effortlessly transition from the strategic/operational down to the tactical events of the Mediterranean air war. Much is drawn from Shores' previous books: *Malta: The Hurricane Years, 1940–41*; *Air War for Yugoslavia, Greece and Crete, 1940–41*;[1] and *Dust Clouds in the Middle East: The Air War for East Africa, Iraq, Syria and Madagascar, 1940–42*. This is very beneficial, as it provides the authors (and by extension the reader) with an outstanding background/baseline from which to further develop the scope of the new work.

Shores, Massimello and Guest also succeed in succinctly identifying shortfalls within the relationships and capabilities of the different noteworthy personalities that influenced operations. Thus, one is made aware of the extent to which the British government, spearheaded by Churchill, injected itself into the running and execution of Allied operations, often with disastrous results. Conversely, the challenges of developing and maintaining the Axis coalition are also highlighted.

Rounding out the book, the authors have provided an extensive and very useful bibliography that encompasses all of their primary and secondary sources. Highlighting another noteworthy addition, the index is one of the most detailed that I have ever come across. Finally, the book, itself, is of the highest quality printing and binding.

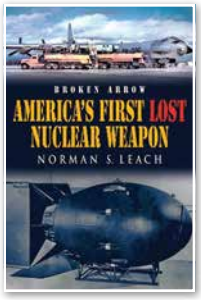
The overall strength of this book lies in its detail. The authors have produced a work of exceptional depth and detail. There is something for everyone; for readers seeking insight into the experiences of those who participated in the Mediterranean war, it is in ample supply; for those looking for detail regarding operations and aircraft, again you will be more than satisfied, and for those who enjoy photography from the period, you will not be disappointed in the least. I was very excited as both a military historian and a casual reader to have had the opportunity to read and review this book. It is a critical addition to academic libraries and anyone looking for details of life in the Mediterranean theatre of war.

Major Chris Buckham is a logistics officer in the Royal Canadian Air Force. He has experience working with all elements including special operations forces (SOF). A graduate of the Royal Military College of Canada, he holds a Bachelor of Arts in Political Science and a Master of Arts in International Relations. He is presently employed as an International Line of Communication (ILOC) officer with the multinational branch of European Command (EUCOM) J4 in Stuttgart, Germany. He maintains a review blog at www.themilitaryreviewer.blogspot.com.

Note

1. These first two books were coauthored with Brian Cull and Nicola Malizia.

BROKEN ARROW: AMERICA'S FIRST LOST NUCLEAR WEAPON



By Norman S. Leach

Red Deer Press, 2008
200 pages
ISBN 978-0889953482

Review by
Dr. Sean M. Maloney

Canada's involvement with nuclear weapons during the cold war is generally ignored either consciously or unconsciously by mainstream academic and media discourse. There are those who sought, and perhaps continue, to deny that this country played a significant and sometimes dramatic role in the cold war. Indeed, acceptance of the fact that Canada was deeply and positively engaged in the US-led deterrent system is diametrically opposed to the existing peacekeeping mythology that continues to be foisted on citizens and students in educational and media venues. As the author of the first comprehensive history of Canada's engagement with nuclear weapons, I am heartened to see the release of *Broken Arrow* by Norman Leach.

Leach focuses on the story of a United States Air Force (USAF) Strategic Air Command (SAC) B-36 heavy bomber, designated Ship 2075. This particular B-36 crashed in British Columbia in February 1950, with the loss of some of its crew and the dramatic rescue of the survivors. What differentiates this crash from the other two B-36 crashes in Canada in the 1950s is the fact that Ship 2075 was uploaded with a nuclear weapon. The fate of the bomber, its crew and the weapon constitutes the narrative of *Broken Arrow*, which is eponymous with a USAF code word for an accident involving a nuclear weapon.

Such accidents are as inherently interesting as they can be controversial. First, the secrecy which surrounds nuclear weapons generates a healthy mystique for almost anything associated with them. Second, the disproportionate attention generated by those who are opposed to the existence of nuclear armament when focusing on accidents involving nuclear systems creates controversy, which draws attention and sells their message. The combination of both secrecy and controversy is a breeding ground for what non-professionals in the field lazily dub "conspiracy theory," which implies some malevolent, indiscernible organization is suppressing information for its own purposes. Parenthetically, conspiracy theory is coded language by some for an unproven hypothesis they are too lazy to work through and challenge. Conspiracy theory is really a particularly circular argument form whereby the evidence that proves there is a conspiracy is non-existent because the perpetrators of the conspiracy are suppressing that evidence.

These semantics become exceptionally important when examining Leach's book, which works through what a B-36 was, why these aircraft existed and the specifics of the incident in February 1950. Though Leach does not explicitly deal with them, a variety of entities, in this case anti-nuclear "peace" and environmental groups that ideologically overlap (particularly in British Columbia), have an interest in demonizing the activities of USAF during the cold war and using accidents like the crash of the B-36 as evidence to support their ideological agenda(s). It is not surprising that USAF was reticent to provide information that could be used to support such agendas, but more importantly, as Leach correctly points out, the detailed specific mechanisms by which nuclear weapons operate should not be proliferated, even 50-year old designs. As a result, *Broken Arrow* undercuts all of the assertions and hypothesis related to the loss of Ship 2075, its crew and the weapon that was on board. There is no conspiracy, just the actions of exhausted men under dangerous conditions during dangerous times.

Broken Arrow is accessible and well illustrated, so hats off to Red Deer Press for not scrimping as other publishers might have. Indeed, as the years pass, fewer and fewer people will know what SAC was, and it is always useful not to assume too much of the future readership. One issue I have is that there are declassified photographs of Mk IV weapons available, and these should have been used instead of the Second World War Fat Man weapon pictures. A section on the development of the Mk IV weapon and its employment by SAC would have nicely augmented the narrative. Contextually, it would also have been useful to add information on the other B-36 crashes in Canada.

That said, *Broken Arrow* is a welcome addition to the literature on Canada and nuclear weapons during the cold war. It is gratifying to see that there is increased interest in that era by Canadian authors, researchers and the publishing industry.

Dr. Sean Maloney serves as the Historical Advisor to the Chief of the Land Staff and is an Associate Professor of History at Royal Military College of Canada. He is the author of *Learning to Love the Bomb: Canada's Nuclear Weapons and the Cold War.*

Abbreviations

SAC	Strategic Air Command
USAF	United States Air Force

CLASHES: AIR COMBAT OVER NORTH VIETNAM 1965–1972

By Marshall L. Michel III

Annapolis, MD: Naval Institute Press, 1997
352 pages
ISBN-10 1-59114-519-8
ISBN-13 978-1-59114-519-6

Review by **Captain Richard Moulton**

While recently attending the Aggressor Threat Academic course, hosted by the United States Air Force's (USAF) 64th Aggressor Squadron at Nellis Air Force Base, the subject book was highly recommended as an in-depth, yet accessible, review of the air war over North Vietnam, which was fought by both USAF and the United States Navy (USN)—specifically the Rolling Thunder (1965–1968), Linebacker (May–October 1972) and Linebacker II (December 1972) strategic bombing campaigns.

As a veteran of the Linebacker campaigns with 321 combat missions in RF-4C (tactical reconnaissance) and F-4E Phantom aircraft to his name and a retired USAF colonel, the author has a lot of personal experience with the subject. He has also done extensive research, utilizing a USAF-sponsored analysis of air-to-air encounters in Southeast Asia (the Red Baron reports), contemporary tactics manuals and articles, end of tour reports as well as a score of books and magazine articles on the subject. While this amount of information could certainly be overwhelming, the author does a good job of ordering the information logically and highlighting the implications of each new development without assuming the reader has familiarity with the air forces of the era.

The book is presented in two parts; the first covers the Rolling Thunder campaign, and the second covers the Linebacker campaigns. The most interesting and most important sections of the book, however, discuss the period after each campaign where USAF and the USN attempt to analyse their respective performances and decide how to move forward. Although inherently less detailed, the analysis of the North Vietnamese responses to each development in the air war was also very informative, emphasizing how their integrated air defence system (IADS)—comprised of anti-aircraft artillery (AAA), surface-to-air missiles (SAMs), interceptor aircraft and very capable ground-controlled

intercept (GCI)—was able to cope while fighting with less-advanced equipment than their American adversaries.

Although the American services had the capability to fly strike missions whenever they desired throughout Rolling Thunder, the North Vietnamese IADS was able to exact a price, in aircraft lost, bombs jettisoned and non-optimal tactics flown. For their part, the Americans brought in electronic countermeasures aircraft and "Iron Hand" flights—the "Wild Weasel" F-105F Thunderchief aircraft—to suppress the North Vietnamese SAMs; primitive airborne GCI in the form of the Lockheed EC-121 Warning Star aircraft for USAF; and an identification, friend or foe, interrogator, which was capable of detecting and deciphering enemy transponders.

At the end of Rolling Thunder in 1968, there was plenty of food for thought for the American services. Top of the list were the Mikoyan-Gurevich (MiG)-21 Fishbed's 3:1 kill ratio against American aircraft during the last year of the campaign, the Air-Intercept-Missile (AIM)-7 Sparrow's dismal eight per cent hit rate and the AIM-9B Sidewinder's only slightly less dismal 15 per cent hit rate. USAF's AIM-4D Falcon, a mid-campaign replacement for the AIM-9B, had scored a nine per cent hit rate. Both USAF and the USN went back to their separate drawing boards and tried to fix what went wrong and came up with drastically different solutions.[1]

USAF decided that the missiles in its inventory were largely good enough and simply needed to be tweaked. The main problem had been, in its assessment, the lack of effective GCI for its pilots to get them into a position to be the first to shoot. They also de-emphasized air-to-air combat in an attempt to maintain the number of pilots needed for continuous operations and to ensure that no pilot had a non-voluntary second tour before all pilots had done a first tour. From the USN's perspective, the AIM-7 Sparrow was not reliable enough for air-to-air combat, but a navy-specific AIM-9D Sidewinder fixed many of the problems found with both the AIM-9B and AIM-4D. Furthermore, the Topgun training programme was introduced to ensure that its fighter pilots and GCI were thoroughly familiar with air-to-air combat before they found themselves in Southeast Asia.

The Linebacker campaigns of 1972 were the testing ground for each service's self evaluation, and the contrast in results was stark. The introduction of laser-guided bombs was a drastic step forward for the Americans, as it expanded the target list available to hit and allowed precision to be maintained from a much higher altitude, reducing the effect of the North Vietnamese AAA and SAMs. The MiG-21s were able to compensate with new tactics and better pilots, but the limited number of sorties that could be generated did hamper the IADS as a whole.

At the end of the Linebacker campaigns, USAF had recorded a 2:1 kill ratio against the North Vietnamese, much behind the USN's 6:1 kill ratio. For missiles, while USAF's AIM-9J Sidewinder and AIM-7E2 Sparrow both had 12 per cent success rates (the AIM-4D had been dropped), the USN's own AIM-9G Sidewinder had scored a much better 46 per cent hit rate. In terms of pilot training, USAF pilots were quick to identify the intensive Topgun programme as one reason for these drastically better numbers from their navy counterparts.

Although the change was not immediate, after the close of the air campaign over North Vietnam, USAF began to slowly adopt the lessons learned from their own experience and the USN's success during the Linebacker campaigns. Red Flag, the USAF version of Topgun, was begun, and dedicated Aggressor squadrons were stood up to replicate a realistic threat during training. For both services, the experiences over North Vietnam greatly informed the development of new aircraft, including the F-14 Tomcat, F-15 Eagle and E-3 Sentry.

CF Photo: Pte Vaughan Lightowler

On the whole, this was an excellent book, which looked at factors from the individual engagement level up to strategic-level decisions and how they affected the success of American air power over North Vietnam. The interplay of the cat-and-mouse developments between both American services and the North Vietnamese IADS was well presented, as was each service's period of self evaluation following Rolling Thunder and both Linebacker campaigns. It is definitely recommended for anyone interested in, or getting a basic grasp of, the many factors that contribute to planning and executing an air campaign against a competitive opposing force.

Captain Richard Moulton is an aerospace control officer in the Royal Canadian Air Force. His previous experience includes a posting with 21 Aerospace Control & Warning Squadron at the Canadian Air Defence Sector in North Bay and a six-month deployment on Op FOUNDATION, augmenting USAF's 71st Expeditionary Air Control Squadron at Al Udeid Air Base in Qatar. He is currently employed as a weapons director instructor with 51 Aerospace Control & Warning (Operational Training) Squadron in North Bay.

Abbreviations

AAA	anti-aircraft artillery
AIM	Air-Intercept-Missile
GCI	ground-controlled intercept
IADS	integrated air defence system
MiG	Mikoyan-Gurevich
SAM	surface-to-air missile
USAF	United States Air Force
USN	United States Navy

Note

1. The AIM-7 is a medium-range, semi-active homing air-to-air missile. The AIM-4D air-to-air missile was produced in both heat-seeking and radar-guided versions. The AIM-9B is a short-range, infrared homing air-to-air missile. Changes in letters assigned to each missile number indicate improved versions of that missile.

Individual Training and Education (IT&E) Modernization for the Canadian Armed Forces

By Lieutenant-Colonel Debbie Miller, OMM, CD, MA, MDS

(Reprint from the *Canadian Military Journal* Vol. 13, No. 4, Autumn 2013)

"Learning without Borders"

Seems too good to be true? Let me provide you with an over brief on the Individual Training & Education Modernization initiative, as well as what is presently being facilitated by the Canadian Defence Academy (CDA).

The Canadian Armed Forces (CAF) is known for the individual and collective high-level performance of its personnel. It does not mean that the IT&E system is perfect. In the current IT&E system, nine strategic gaps were identified, which served to motivate the creation of the IT&E Modernization Strategy. This Strategy guided the Training Authorities / Designated Training Authorities (TA/DTA) partnership in the development of CAF Campus, which is described in the CAF Campus Operational Framework. It should be noted that on 19 June 2013, IT&E Modernization was endorsed by Armed Forces Council (AFC).

So what is included in this initiative? In other words, what can it do for you? It will allow you to enter a portal that will provide boundless access to a myriad of applications, anywhere and anytime. This approach will break down the 'stovepipe' construct of the present IT&E system, thereby fully leveraging all IT&E initiatives and investments and ensuring that the organization, processes, doctrine, and policy evolve in concert with the learning methodologies and tools employed in CAF Campus. CAF Campus will provide effective management of IT&E while preserving the TA/DTA structure. It will leverage the authorities of the Professional Development Council (PDC) members and participants to oversee the transformation of the CAF learning culture. Acting as an integrator, it will supervise a transition in capabilities and approach that will achieve the required synergy, cooperation, and strategic governance.

There will be a significant transformation of the CAF learning culture that will be motivated by the implementation of this modern learning architecture. CAF Campus will affect traditional training approaches and embrace the nature of a true modern learning organization. The opportunity to achieve these strategic advantages cannot be disrupted. As such, the transformation will

be supported by an overarching management plan and well-tailored communications to prevent institutional inertia from causing a retreat to traditional approaches.

CAF Campus modernizes IT&E in three domains: Governance; Training Authority and Designated Training Authority Capabilities; and Common Capabilities. Although critical to overall efficiency, it is not the common capabilities that will represent IT&E Modernization to the IT&E community. Front and center in this new approach will be the reconfiguration of the following organizations to meet their unique requirements:

- Learning Support Centres (LSC) — will provide integrated learning development functions, and IT&E specialist consultancy services that will be essential to the TAs/DTAs, FCoEs [Functional Centres of Excellence] and TEs [Training Establishments] when conducting needs assessment, analysis, design, evaluation, validation, intelligent contracting and rationalization of IT&E;

- Functional Centres of Excellence (FCoE) — will lead, coordinate and maintain the intellectual foundation and authoritative body of knowledge within their assigned area of expertise in support of IT&E;

- Training Establishments (TE) — will provide cadres of instructors, standards staff and IT&E managers engaged in learning delivery regardless of physical location or delivery environment; and

- Learning Sites (LS) — temporary or permanent locations providing physical and/or virtual learning environments shared by multiple FCoEs and TEs.

As for the Common Capabilities, they will be provided by CDA to avoid redundancy and to enable ready access to essential capabilities, including point of need IT&E, as well as pan-CAF collaboration to support all IT&E phases with access to a greater spectrum of best practices and talent than any TA/DTA could achieve on its own. These capabilities will be grouped into three categories: Strategies and Programs (Prior Learning Assessment Review, Rationalized Training Delivery, and so on), Support and Services (Research and Development, Instructor Development Program, and so on), and CAF Campus Enterprise Engine (CAFCEE). CAFCEE will be the technical backbone to CAF Campus, providing access to the tools that support CAF Campus, and, in particular, enabling a collaborative learning environment and ubiquitous and asynchronous access to IT&E. The CAFCEE was not conceived as a 'stand-alone' system.

The LSC network will be equipped to provide a common baseline of integrated learning development services, consultancy services, and support services. The LSCs will provide the main development capabilities and IT&E specialist consultancy services, centralized contracting, and the rationalization of IT&E. Each LSC will participate in a virtual development network that will enable sharing of expert advice and best practices. In some cases, individual LSCs will be equipped with specialty capabilities that will serve the entire LSC network. All LSCs will be reinforced with development tools and other support services from the CAF Campus Common Capabilities. The main development capability for the Designated Training Authorities (DTAs) will be provided by the CAF LSC. In addition to the LSCs, some development and common service will also be accessed at satellite LSCs that are linked to an LSC and the entire development network. The LSCs will be virtual, physical, or some combination thereof, and will provide support to one another. They may be a section within a headquarters, or a stand-alone unit with the necessary establishment, authority and funding to meet their mandate. The specific design of each LSC depends upon the intended scope of activity, and it is determined by a combination of factors,

including the TA's development and common services requirements and the specialized capabilities that specified TAs will provide to the entire development network. For example, the production of holographic maps or images is an expensive capability that would be established at a single LSC to support all TA/DTA requirements. While the LSCs operate under the ownership of each TA, the establishment and evolution of the LSC network consistent with a CAF-wide standard level of capability is a CDA HQ responsibility on behalf of Professional Development Council.

It is envisioned that improved resource management, in concert with the reduction in formal training, reduces infrastructure, and operational equipment requirements, will yield savings. At present, the IT&E system consumes $1.6B annually; a 1 percent efficiency improvement would produce $16M in annual savings, and a 10 percent improvement would produce $160M in annual savings. CAF Campus is committed to using the approach of continuous improvement and rationalization of learning content and organization, including the supporting doctrine, policies, and procedures.

The following four projects were selected to support the Initial Operational Capability (IOC):

- Learning Support Centres — will provide the main learning content development capability and IT&E specialist consultancy services;
- CAF Campus Enterprise Engine — will include the operating platform, related capabilities and key tools, A digital learning management system with 24/7 access to learning, with a learning content repository;
- Performance Management Framework — will provide metrics to guide strategic and operational decisions regarding the ongoing evolution of CAF Campus, and will provide Program Alignment Architecture (PAA) inputs; and
- Common Capabilities — will include the enterprise tools and capabilities that enable the efficient application of modern instructional techniques.

This CAF-wide learning initiate serves as a national reference for all learning projects and related research agendas within the CAF/DND, and allows the IT&E community to promote, share, or request projects. Through pan-CAF collaboration, CAF Campus will provide access to a greater diversity of experience and talent than any TA/DTA could ever provide on its own. The CAF Campus environment is modern and adaptable, where multi-use mobile learning devices access wireless internet-based learning networks. In fact, technology plays a secondary role in support of the CAF Campus, which will adapt by responding in concert with other elements of the CAF to changes in operational and institutional requirements, changes in operational tempo and the discovery of more effective and efficient learning methodologies. The Campus framework will allow the synchronization of HR [human resources] and IT&E, supporting 'just-in-time' training and career-long individual development. The CAFCEE supports not just access to learning content but also access to support resources and collaboration via online learning communities where learners, instructors and developers can share, build and tailor learning content and supporting applications.

In the end, the CAF Campus positions the CAF to maintain its operational edge in the face of resource constraints and an increasingly complex and challenging security environment. It is a strategically driven, pan-CAF synchronized performance oriented learning architecture that supports the transformation of the CAF learning culture for the 21st Century.

To the day-to-day user the fundamental facilities of the LSC coupled with the functionality of the Enterprise Engine are of most interest, as they are readily available aspects that anyone can use, anywhere, at anytime, basically point of need for the user.

Every CAF member will be a user, and will have access to the tools (virtual resource centre, learning plan, 3D models, R&D reports, synthetic environments, serious games, micro-blogging, and so on), and resources appropriate to their particular status as a learner, instructor, content developer, instructional designer, or training manager/administrator when and where they are needed.

IT&E Modernization will meet operational requirements by creating a modern, agile, integrated learning environment with global access that empowers Canadian Armed Forces personnel.

Come visit us and see what it is all about at http://www.forces.gc.ca/en/training-elearning/index.page

Lieutenant-Colonel D. L. Miller, OMM, CD, is the Senior Staff Officer Strategic Planning at the Canadian Defence Academy in Kingston. She holds a Master of Arts in History and a Master of Defence Studies from the Canadian Forces College.

Abbreviations

CAF	Canadian Armed Forces
CAFCEE	Canadian Armed Forces Campus Enterprise Engine
CDA	Canadian Defence Academy
DTA	designated training authority
FCoE	functional centre of excellence
IT&E	individual training and education
LSC	learning support centre
TA	training authority
TE	training establishment

CF Photo: Cpl Brandon O'Connell