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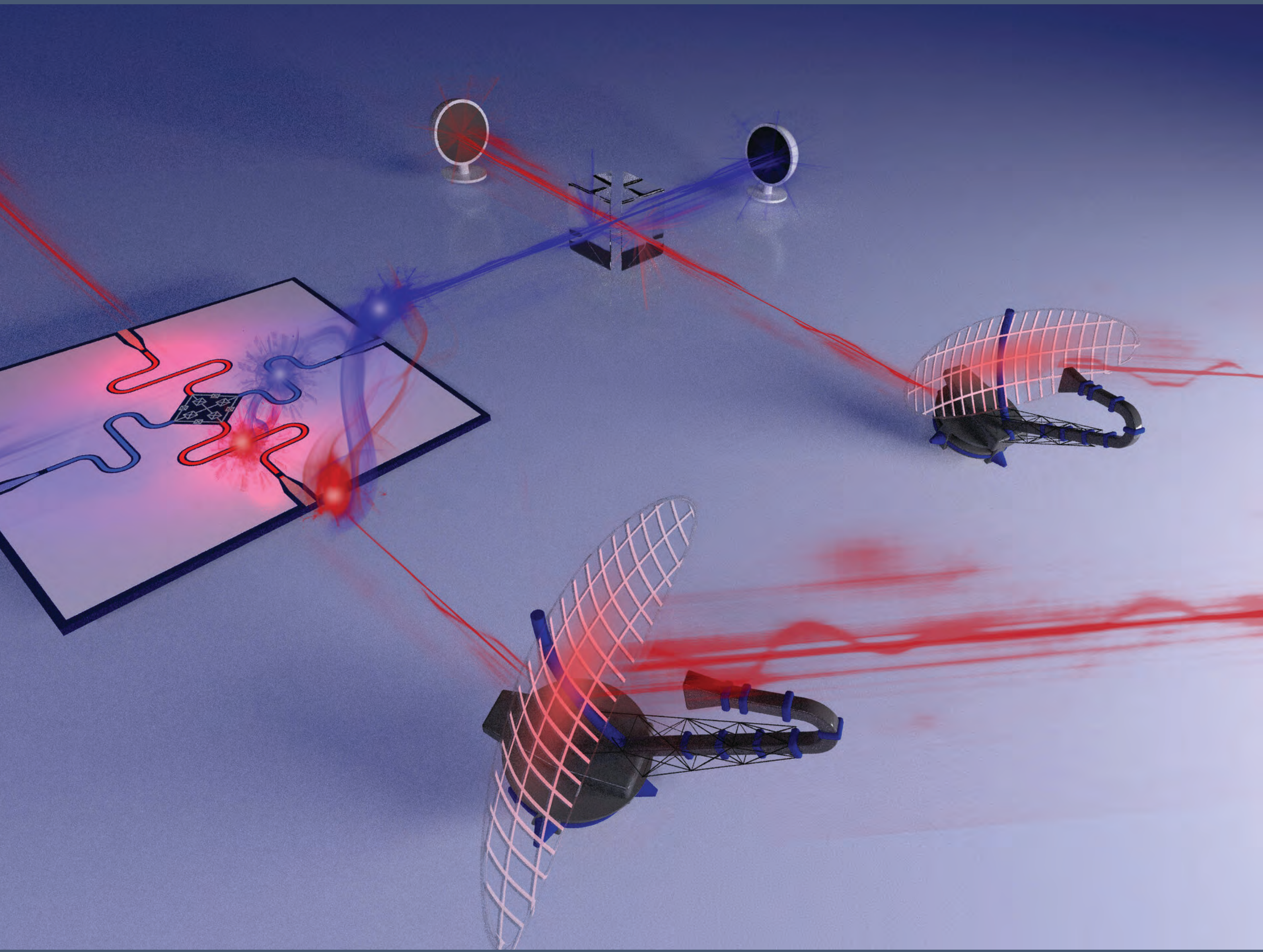

Illustration of a quantum radar prototype created by physicists at the Institute of Science and Technology Austria. Image used with permission. Credit: © IST Austria/Philip Krantz

# Future Tech: Quantum Radar

## Is investment in quantum radar capability worthwhile for the CAF/RCN?

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# Maritime Engineering Journal

*(Established 1982)*
**Fall 2024**

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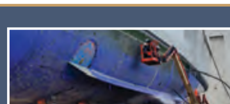

Advances with Pulsed Eddy Current Deck and Hull Surveys.
Photo courtesy NETE and FMF Cape Scott



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## COMMODORE'S CORNER

# The Naval Engineering Test Establishment (NETE): Trusted GoCo Partner for More Than 70 Years

By Commodore Keith Coffen, CD

On August 15, it was my distinct pleasure to preside over a change of command ceremony at the Naval Engineering Test Establishment (NETE) in Montréal, one of our two DGMEPM (Materiel Group) field units. **Capt(N) Christian Nadeau** was relieved by incoming CO, **Cdr Darryl Gervis**.

Christian and I are the last two serving officers left from our 1996-97 CSE applications course, and it is wonderful to see him promoted. He is leaving the technical community for the next couple of years to work as a force developer with Canadian Forces Intelligence Command (CFINTCOM), and we wish him fair winds and following seas.

Darryl is a fellow submariner, and was CSEO of HMCS *Victoria* (SSK-876) when that submarine demonstrated the potent capability of the Mk 48 torpedo, sinking the former USNS *Concord* (T-AFS 5) with a single shot during a live-fire exercise at RIMPAC 2012. He is the first submarine qualified officer to be appointed CO NETE, and we wish him all the best in his new position.

NETE was established in the early 1950s in partnership with what was then the Weir-owned Peacock Inc., and has been a trusted partner to MEPM and the RCN for more than 70 years. Operating on a government-owned, contractor-operated (GoCo) model, Weir Marine Engineering provides the necessary corporate structure, expertise and support, while Canada provides government-owned equipment, funding on a task-based model, and – since the 1970s – a military commanding officer. More recently, we've also assigned an Ottawa-based Deputy CO to the command structure.

NETE has benefitted over the years from the direct participation of a significant number of RCN sailors and officers from all occupations, including some who have joined the company following full military careers. This type of continuity is priceless. **Serge Lamirande** and **Joël Parent**, both former COs of NETE, ended up taking on senior civilian leadership roles following their retirement from distinguished careers in the CAF. While Serge has since fully retired, Joël continues to lead as General Manager. Both of these exceptionally motivated former Naval Technical Officers have made their mark in ensuring that NETE remains perfectly aligned to RCN/MEPM goals, strategic priorities, and to uncompromising standards for engineering excellence, equipment reliability, and personnel safety.

Photo courtesy André Gauvreau
Naval Engineering Test Establishment

Capt(N) Nadeau, with Cmdre Coffen and Cdr Gervis.

NETE provides a diverse array of services such as shock and environmental qualification, submarine escape equipment evaluation, communications system engineering, test and evaluation, cybersecurity, submarine materiel assurance, and ship and submarine materiel state validation. Simply put, the Naval Engineering Test Establishment is at the core of much of what we in MEPM do in providing materiel, and materiel assurance, to the RCN.

Having seen NETE in action from almost the first day I stepped on board the brand-new HMCS *Regina* (FFH-334) as an A/SLt in 1995, I would offer that the capability offered by NETE is invaluable, and has positively impacted the RCN in ways seen and unseen for generations. With the award of the "NETE 3" contract to Weir Marine Engineering last April, I think it is safe to say that the relationship will remain solid for decades to come.

IN MEMORIAM

# Rear-Admiral Eldon (Ed) James HEALEY, CMM, CD
# (Aug. 11, 1934 – Aug. 26, 2024)

Canada's Naval Technical community was saddened to learn of the passing of RAdm (Ret'd) Eldon Healey in Ottawa on Aug. 26, at the age of 90. The Owen Sound, ON native, widely considered to be "the father" of the Canadian Patrol Frigate program, served 32 years as an engineering officer in the Royal Canadian Navy before retiring in 1985 as Chief of Engineering and Maintenance for the Canadian Forces. He would continue his service to Canada as the civilian Assistant Deputy Minister (Materiel) for the Department of National Defence from 1985 to 1990, before moving on to a spell in private industry.

RAdm Healey had a remarkable career, defined in part by his experience with some of the largest naval ship procurement projects of his era — from HMCS *Provider* (AOR-508) in 1963, to the CPF and Tribal Class Update and Modernization (TRUMP) programs of the 1980s. In his final appointment as ADM (Mat), he was responsible for all procurements within DND. His personal style was characterized by a determination to see things done properly, and he knew how to bring parties together. In a 2009 oral history interview for the Canadian Defence Industrial Base (CANDIB) project, he said: "If you design (your procurement) ... without flexibility in your process, such that it can't take a few hits here and there, then you are doomed to have a difficult procurement."[1]

His proudest career achievement, say his family, was delivering Canada's *Halifax*-class frigates, which continue to serve as the backbone of the RCN's surface fleet. As Project Manager for the CPF Project from 1980 to 1984, then Cmdre Healey managed what was at the time the largest naval procurement project in Canadian history. Navigating a complex contract approval process, he successfully delivered two batches of six modern patrol frigates ahead of schedule and under budget.

In 2014, former DGMEPM RAdm (Ret'd) Richard Greenwood wrote in An Engineer's Outline of Canadian Naval History, Part III (1970-2014), "The CPF Project was a massive undertaking for the Canadian naval engineering

Canadian Armed Forces photo

Combat Camera photo by Sgt Kevin MacAulay

establishment, involving the weaving-in of many lessons from previous procurements ... It initiated a significant change in the maintenance philosophy of the Canadian navy."[2]

The CANDIB team wrote that, even before becoming PM CPF, "RAdm Healey advocated tirelessly with the political administration of the day to have the CPF project approved... at great risk to his career as he was assuming a role exceeding his mandate." The frigate program would eventually introduce significant economic benefits to Canada's maritime industry, and contribute to the maturation of many key industries, including electronics, software, and systems integration.

His efforts did not go unnoticed. He was made Commander of the Order of Military Merit in 1983, and in 2015 was co-recipient, with VAdm Chuck Thomas, of the Admirals' Medal for "leadership in spearheading the Canadian Patrol Frigate program from concept to implementation."

Ever the gentleman and family man, Eldon Healey threw great effort into his volunteer work with a number of defence-related and charitable organizations. He is survived by his wife of 62 years, Beverly Anne, his children, David, Anne and Chris, and grandchildren James and Sydney.

1. https://www.cntha.ca/tech-hist/oral-written-hist/histories/edhealey.html
2. The Northern Mariner/Le marin du nord XXIV, Nos. 3 & 4 (Jul. & Oct. 2014), 273-295 / Canadian Military History 23, Nos. 3 & 4 (Summer & Autumn 2014), 273-295.

FORUM

# From Military Brat to Submarine Engineering Co-op Student: My Summer Work Term Experience with DND

By Kathryn Basinger

Growing up as the child of a military engineering officer has filled my life with constant adventure, new people, and uncertainty. Our postings to Edmonton, AB, Fredericton, NB and Ft. Leavenworth, Kansas had their own charms, and offered many new experiences. And while being raised in a setting that was constantly changing created uncertainty, it instilled a sense of adventure and adaptability in me that continues to influence me to this day.

Since starting high school, I knew I wanted to study engineering. Considering my father's choice of degree program, and my own interest in problem-solving, math, and science, I eventually decided to enter biomedical mechanical engineering at the University of Ottawa. I initially intended to work on prosthetics and medical devices that could improve people's quality of life, but have since learned to love mechanical engineering as a whole.

When I saw the university's co-op listing for the Department of National Defence, I knew that applying would allow me to see the military —an integral part of my life thus far — from a different perspective. This summer's employment ended up being more than just a simple co-op work term; it became a bridge between my personal history and my professional aspirations.

Working with DND, I was able to gain first-hand experience with the professional side of engineering, and get a better understanding of what my future might entail. I worked as a student on the Royal Canadian Navy's *Victoria*-class submarine weapons handling and discharge system, with fantastic guidance and supervision from **LCdr Fady Elsabagh**, and **Salih Abouassali**. I quickly went from barely understanding the acronyms to feeling confident in contributing to discussions, and providing preliminary recommendations on items such as design changes or life extensions for catalogued parts.

My initial tasks involved writing trip reports for visits to CANSEC, the largest defence industry trade show in Canada, and to the Naval Engineering Test Establishment (NETE) in Montréal. CANSEC enlightened me to future career opportunities and the business aspects of engineering, while the NETE visit introduced me to the technical aspects of this remarkable engineering and test facility. The trip report for NETE included a summary of discussion for safety factors relating to a new heavyweight torpedo embarkation trolley that is being commissioned by the Navy.


Submitted photo

Other tasks included preparing a report regarding the recommended hardness of O-rings in the submarine weapons handling and discharge system, and bringing seven engineering changes (ECs) to the "approval to close" gate, some of which had been initiated before I was born. I also worked on creating program views to summarize the current status of our DMEPM SM 3-3 subsection. My final main task, that I initiated myself, was to create an introductory document to give future students and DND employees a solid contextual foundation for what SM 3-3 does.

My journey from being a military brat to an engineering student working with DND is a testament to how our backgrounds can shape our futures. My upbringing provided a foundation of adaptability and curiosity that led to a wonderful summer with DND, and I am very grateful for my summer spent in SM 3-3. It was a great learning experience.

*Kathryn Basinger is a 3rd-year student in the University of Ottawa's Biomedical Mechanical Engineering program.*

FORUM

# The Naval Engineering Test Establishment: A Pillar of Naval Excellence

By Capt(N) Christian Nadeau

After a little over a year as Commanding Officer of the Naval Engineering Test Establishment (NETE), I have had the honour of being succeeded by **Commander Darryl Gervis**. Reflecting on my time at NETE, I am continually amazed by the breadth of work this establishment undertakes. For those who have visited NETE in Montréal, or collaborated with its team members, you likely share my admiration. For others, I would like to offer an overview of this vital organization, its history, services, and future direction.

## Mandate of NETE

NETE's mandate is critical to the operational readiness of the Royal Canadian Navy (RCN), by providing 4th-line engineering services and field testing in support of naval materiel for the Canadian Armed Forces (CAF). Specifically, NETE delivers expert test & evaluation (T&E) services, along with independent verification and validation (IV&V) to the RCN, the Director General Maritime Equipment Program Management (DGMEPM), and major capital projects. NETE's overarching goal is to protect the interests of the RCN.

## History of NETE

**1951-54:** NETE was established in Montréal, strategically co-located with the *St. Laurent*-class DDE-205 destroyer escort design office, naval shipbuilding industry, and facilities supporting the testing of naval components such as valves and steam-turbine propulsion engines.

**1966-72:** The facility expanded its capabilities to include testing gas-turbine engines like the Solars and FT-12s produced by Pratt & Whitney.

**1974:** NETE was integrated as a field unit under the Assistant Deputy Minister (Materiel).

**1987:** Combat systems were added to NETE's mandate, and permanent coastal representatives were introduced, particularly to support the *Halifax*-class frigates.

Photo courtesy André Gauvreau
Naval Engineering Test Establishment

Capt(N) Christian Nadeau with NETE General Manager Joël Parent.

**1990s:** NETE began playing a pivotal role in the development and support of advanced communication systems, and contributing to the frigate operational test & evaluation program.

**2000s:** The organization transitioned from a "sole source and cost plus" model, to a "competitive and performance-based" approach, marking a significant contractual evolution. NETE also responded to specific needs by bringing in subject matter experts, notably from the Royal Navy, to support the SSK Submarine Escape System program.

**2017:** NETE completed a modernization and upgrade project, expanding its facilities by approximately 10,000 square feet (929 $m^2$). This included purpose-built communication and combat systems labs, and modernized infrastructure to meet contemporary code requirements.

**2017-present:** NETE established a centre of excellence (CoE) for uncrewed vehicles, improved on its modeling & simulation capabilities, and operationalization of corrosion detection technology. An example of the use of these assets and new capabilities by NETE was featured in issue 106 of the *Maritime Engineering Journal*, and as the lead article in the present edition.

**2024:** The NETE 3 contract was awarded to WEIR Canada with option years for up to 20 years.

*(Continues next page...)*

## Current Staffing and Structure

NETE operates as a government-owned, contractor-operated (GoCo) organization, embedding approximately 400 personnel, primarily engineers and technologists, within the Department of National Defence (DND) and the RCN. These professionals bring specialized expertise in marine systems, combat systems, naval architecture, as well as information and communication systems, all dedicated to serving the RCN.

## Core Services

NETE's core services span a wide range of critical functions, including:

1. Assessment of equipment/systems/software performance vs. requirements
2. Assistance in the conduct and development of trials
3. Evaluation of design changes
4. Independent verification and validation (IV&V)
5. Data recording, reduction and analysis
6. Problem investigation and analysis
7. Support of ranges
8. Support to innovation
9. IV&V of materiel acquisition and support processes

Examples of NETE's work include qualification testing (e.g., shock, vibration, environmental, engine testing), material qualification (e.g., pressure/burst testing, shock, vibration, etc.), cyber penetration testing, and the use of advanced technologies like pulsed eddy current scanning for corrosion detection.

## Business Model

NETE's business model is built on key tenets that ensure the organization's independence, strategic capability, and responsiveness to the Navy's needs. This includes a strict policy on conflict of interest, a performance-incentivized structure, and full transparency through regular reporting and audits.

## Marine Systems / Combat & Control Systems

NETE's Marine Systems section capabilities include qualification and performance testing, material testing, environmental protection, naval architecture, corrosion surveys, and system modeling & simulation. Meanwhile, the Combat & Control Systems section focuses on fleet support, IV&V, and engineering support for new capabilities and ship survivability assessments.

## Information and Communication Systems (ICS)

The ICS section supports the RCN in areas such as naval information systems (NavIS), data communications, information technology security, and the Defence Resource Management Information System (DRMIS). The section's work is crucial in maintaining the integrity and security of naval communication and information systems.

## Testing and Infrastructure

NETE's infrastructure is maintained by a dedicated team responsible for the operation of the LaSalle Test Facility, shop services, IT systems, and procurement logistics. The Safety, Health, and Environment (SHE) Management Program ensures compliance with industry standards, and promotes a safe working environment across NETE's diverse operations.

## Future Direction

NETE's future is mapped out in its Strategic Capability Plan (SCP), initiated in 2021 and updated in 2024 to reflect the new NETE 3 contract. The plan outlines several key initiatives:

- **Personnel Growth:** Anticipates increasing the workforce to 500 personnel over the next five years.
- **Atlantic Test Facility:** Considers establishing a new facility to accommodate existing personnel, and support unmanned vehicle operations.
- **Service Expansion:** Aims to become a centre of excellence for artificial intelligence and additive engineering.
- **CPSP Support:** Plans to enhance support for the Canadian Patrol Submarine Project.
- **LaSalle Recap Project:** Recommends addressing IT-related infrastructure needs, and expanding space for classified work.
- **Recognized Organization Designation:** Seeks to achieve Recognized Organization (RO) status from the Naval Materiel Regulatory Authority (NMRA).

## Conclusion

NETE stands as a cornerstone of naval engineering excellence, dedicated to supporting the RCN's operational needs through rigorous testing, evaluation, and innovation. As NETE moves forward under the leadership of Cdr Darryl Gervis, it remains committed to advancing its capabilities, and ensuring the continued success of the Royal Canadian Navy.

Photo courtesy Naval Engineering Test Establishment

FEATURE ARTICLE

# RCN Corrosion Management: Advances with Pulsed Eddy Current Deck and Hull Surveys

Article coordinated by Cameron Walker, ICE Dragon Corrosion Inc., with submissions from LCdr Shane Kavanagh FMFCS, Lt(N) Matthew Hewitt FMFCS, Ryan Williamson NETE, David Bernier NETE, and Brycklin Wilson, ICE Dragon Corrosion Inc.

Like many ship classes before them, the *Halifax*-class frigates will be required to extend their intended service life; specifically, until the arrival of the new Canadian surface combatant fleet of River-class destroyers. To meet this requirement, in-service structural surveys, including any corrective action, will be necessary to ensure that the frigates are structurally fit to perform their assigned tasks.

To this end, the Major Surface Combatant 8 section of the Directorate of Maritime Equipment Program Management (DMEPM (MSC)) tasked the Naval Engineering Test Establishment (NETE) in LaSalle, QC to find a solution for conducting deck surveys for metal loss and corrosion. As a field unit of the Materiel group, NETE provides independent verification and validation, as well as expert test and evaluation services to the Royal Canadian Navy (RCN).

Traditionally, surveying and inspecting naval vessels has been a labour-intensive process, demanding significant resources of personnel, time and ultimately money. Complete visual surveys of interior/exterior decks and hull sections usually require the full removal of insulation and protective coatings. Recognizing the need for greater efficiency and improved detection of metal loss without extensive strip-outs, the RCN, with Assistant Deputy Minister (Materiel), embraced modern technology to revolutionize their inspection procedures.

In 2018, the development of the pulsed eddy current (PEC) system for RCN applications began when MSC tasked NETE with evaluating a candidate for non-destructive testing (NDT) technology capable of assessing steel conditions of compartments on *Halifax*-class frigates prior to removal of any deck coverings. Several technologies were considered: ultrasonic testing (UT), thermography, X-ray, guided wave, and PEC testing. After reviewing the available technology and equipment, PEC was selected for its superior ability to penetrate tiling, protective coatings and insulation, as well as for its compact field-ready system requiring minimal adaptation for the intended purpose.

## How PEC Scanning Works

Pulsed eddy current scanning is a non-destructive technique used to detect corrosion, damage, or remaining thickness of metallic materials, particularly ferromagnetic materials. PEC scanning operates on the principle of electromagnetic induction. An electrical pulse uses a step function voltage to excite the probe, generating a magnetic field, which induces eddy currents in the conductive material under inspection. By analyzing distortions and decay in the resultant eddy currents, the continuum of frequencies can be measured and recorded. Technicians can then measure variations in material properties such as relative volume, even through coatings and insulation. This ability to see through layers makes PEC scanning particularly valuable in situations where traditional methods might require the removal of protective coatings or insulation to expose the underlying metal, thus saving both time and resources.

PEC scanning comes with pros and cons compared to other NDT techniques such as ultrasonic testing. One of the standout benefits of PEC is its ability to inspect large areas quickly and efficiently without direct contact with the material under investigation, which is a significant advantage in hazardous or hard-to-access areas (Figure 1). Additionally, PEC's proficiency in assessing ferromagnetic materials

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All images courtesy Fleet Maintenance Facility Cape Scott and the Naval Engineering Test Establishment

Figure 1. PEC scanning technology offers insight on the state of corrosion in hard-to-access areas of ship structure, allowing maintenance personnel to know which sections need to be opened up for repair.

through non-conductive coatings provides a distinct edge over UT methods, which often struggle with signal attenuation. However, PEC scanning does have limitations. Its effectiveness diminishes with non-ferromagnetic materials, or with complex geometries, whereas UT methods can provide higher-resolution detail, and pinpoint exact defect locations and dimensions with precision. Since PEC scanning offers more qualitative insights about corrosion and thickness, it is often paired with UT scanning to optimize the overall coverage and data of scans.

## PEC Scanning Trials

In its early development stages, PEC was initially a single-element probe system intended for pipe inspections, which posed two immediate concerns for deployment on a ship's deck: First, the single-element design meant that it would take a considerable amount of time to fully cover large compartments on frigates; second, pipes are comparatively devoid of the structure, welds, and interference features normally associated with the deck of a frigate, complexities that can affect the accuracy and evaluation of readings.

Quebec City-based NDT company Eddyfi Technologies (est. 2009) was called in by NETE to assist. In its early years the company focused on eddy current array (ECA) technology, and has since expanded to include other NDT technologies and capabilities. Initially, Eddyfi was unsure of the effect of stiffeners and welds on the quality of data collection. During the initial familiarization training, however, NETE conducted a scan of the steel stairwell at Eddyfi's offices, which had a structure similar to that of a frigate deck. This impromptu test demonstrated that the interference from the structure and its weldments was minor, and provided the confidence to proceed with on-site deck-scan trials on board HMCS *Toronto* (FFH-333).

The *Toronto* trials (Figure 2) proved that the technology could detect corrosion in the presence of structures on the decks of frigates, but the single-element probe proved to be an area requiring improvement in terms of speed and efficiency. NETE constructed a full-scale test panel emulating the various flooring types, plate thicknesses and obstacles present on the frigates, and collaborated with Eddyfi to design a custom 7-channel array probe optimized for frigate decks (Figure 3). The new array provided seven times the coverage of a single-element probe, increasing scan speeds considerably. Through a combination of high-sensitivity coils and the nature of a PEC array probe, the custom array was also able to detect smaller defects than the single-element probe. Figure 4 shows an example of the output of the 7-channel probe.

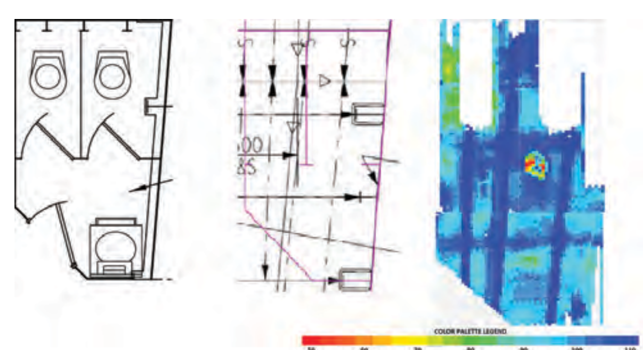
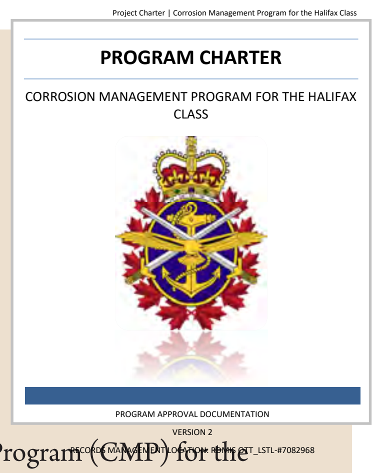



Figure 2. First scan of a heads & washplaces deck using the single-element probe.

### Corrosion Management Program


Project Charter | Corrosion Management Program for the Halifax Class

PROGRAM CHARTER

CORROSION MANAGEMENT PROGRAM FOR THE HALIFAX CLASS

PROGRAM APPROVAL DOCUMENTATION

VERSION 2

RECORDS MANAGEMENT LOCATION: RDIMS OTT_LSTL-#7082968

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Since early 2022, the Directorate of Maritime Equipment Program Management (Major Surface Combatant), and the Directorate of Naval Platform Systems have been developing a Corrosion Management Program (CMP) for the *Halifax*-class frigates. The program is supported by management processes and resources that enable people and organizations to effectively implement and sustain best corrosion management practices. The CMP framework is based on the National Association of Corrosion Engineers (NACE) Impact Study 2016, which provides 12 pillars of best practice. The aim of the program is to directly support the *Halifax*-class End of Life (EOL) plan, while building a blueprint for a fleetwide CMP.

The primary team of the Corrosion Management Program includes: **René Blais** from DMEPM (MSC 8) as CMP project manager; as well as ICE Dragon Corrosion Inc consultants **Dr. Zoe Coull** (CMP development lead), **Brycklin Wilson** (CMP technical project engineer), and **Cameron Walker** (CMP coordinator). The program is sponsored by **Mark Sheppard** (DNPS), and **Capt(N) Johnathan Plows** (DMEPM – MSC).


Figure 3. PEC shipboard scanning trials with the custom 7-channel eddy current probe.

In March 2020, PEC scanning was trialed on the hull plating of a frigate in the hope of finding similar benefits. Initial trials showed that the technology was well-suited to this application. PEC scans from the exterior of the hull were overlaid atop a picture of the hull, revealing corrosion on sections of the hull plating not easily accessible from the inside due to interior insulation and/or machinery interferences (Figure 5). Since PEC can scan a full hull plate with 100-percent coverage in less than an hour, the technology is best employed as a preliminary screening tool to pinpoint areas for ultrasonic testing follow-up by a certified Fleet Maintenance Facility NDT technician to measure exact wall thickness losses. This significantly speeds up the survey process and reduces unnecessary UT measurements in corrosion-free areas. During the PEC trials, known defect areas were scanned to confirm the scanning results (Figure 6).

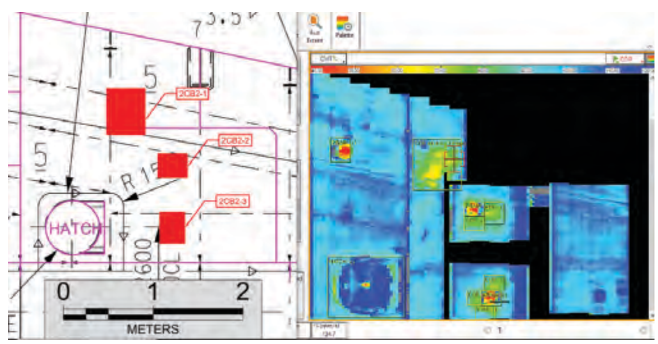


Figure 4. Example of data gathered by custom 7-channel probe on deck plating.

## PEC in Practise

The NETE test results proved the value of the PEC/UT methodology. During the most recent hull surveys of East Coast frigates this year, select hull plates were scanned, and areas of concern were highlighted for additional investigation. Ultrasonic testing then targeted the areas of concern found by the PEC to confirm the findings (Figure 7). The combination of these techniques provided near real-time

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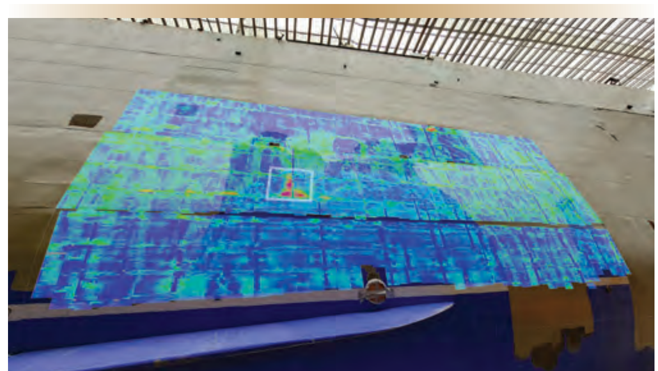


Figure 5. Example overlay of PEC survey scan imaging atop a photo of the hull structure.

assessment of problem areas as the scans were being conducted. In the case of HMCS *Fredericton* (FFH-337), once the ship was up on the Syncrolift, a PEC survey that was conducted by NETE to produce a heat map to guide repair efforts (sample shown in Figure 8), revealed a problem area that warranted immediate follow-up by ultrasonic testing. Within minutes of the UT scan confirming an extremely low wall thickness, the results were submitted to Fleet Maintenance Facility Cape Scott (FMFCS) hull inspectors so that they could conduct detailed internal surveys, including removals as required, and start planning repairs.


Figure 6. Examples of known defects and corresponding scan results from a 2022 hull survey.

Structural surveys of machinery compartment bilges, which have proven to be particularly challenging in the past, are now much simplified, and both HMCS *Halifax* (FFH-330) and *Toronto* would see significant structural renewal in their auxiliary machinery rooms and engine rooms during their docking work periods (DWPs). Prior to these vessels entering DWP, it was generally understood that there would be some structural corrosion in these compartments, but with so much bilge hull structure inaccessible behind machinery, piping and cables, there was little opportunity to complete detailed surveys during their operational cycle.

Following the results of these PEC hull surveys, the technical community desired a better understanding of similar structures in other ships. In February and May of 2024, FMFCS docked HMC ships *Montréal* (FFH-336) and *Fredericton* for four-week interim docking work periods (IDWPs) to complete the required surveys, with previously identified high-risk areas receiving priority. Hull inspectors from the Naval Architecture Office (NAO) of FMFCS had actually completed a sizable portion of their progressive visual surveys for these two ships prior to their IDWPs, and so were able to combine the results of these visual inspections with the lessons learned from *Halifax* and *Toronto*. This allowed the FMF team to build a particularized survey plan to maximize "defect realization opportunities" during the IDWPs.

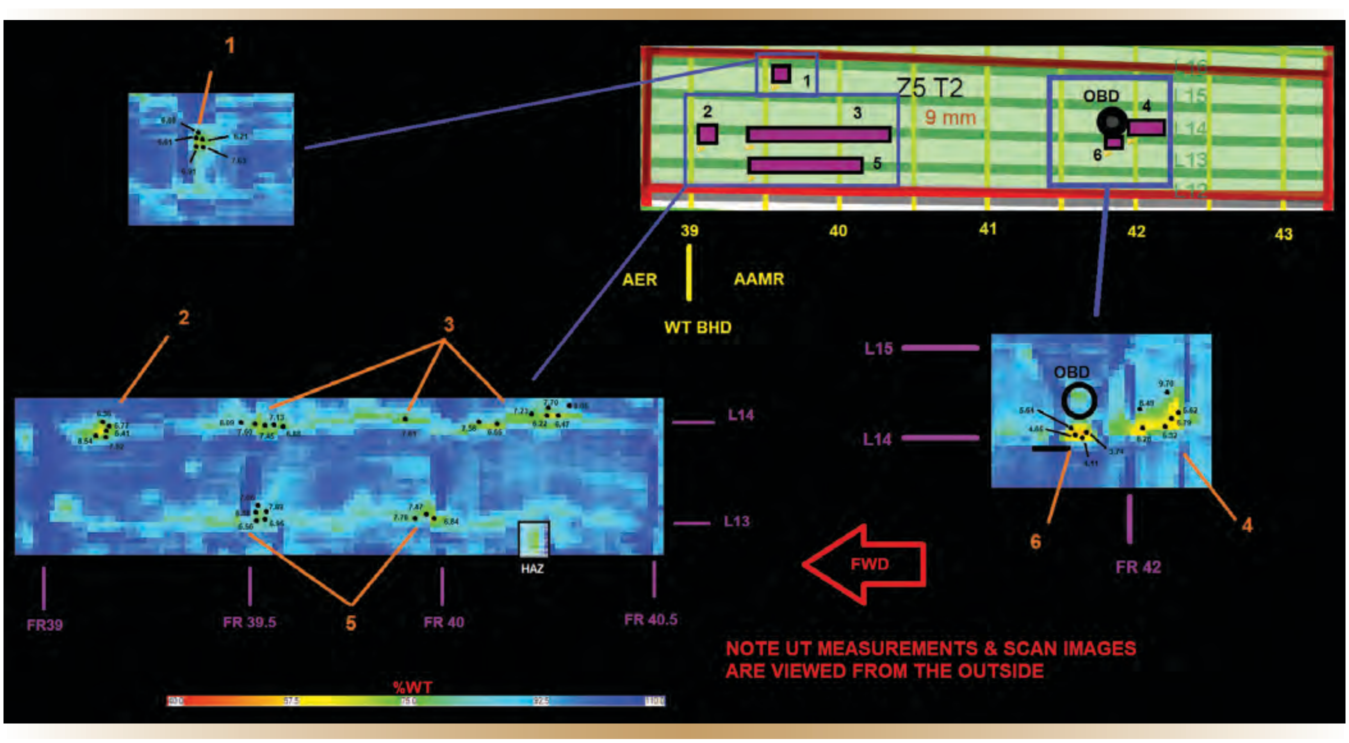



Figure 7. Images showing combined areas of concern revealed by PEC scans and UT readings.

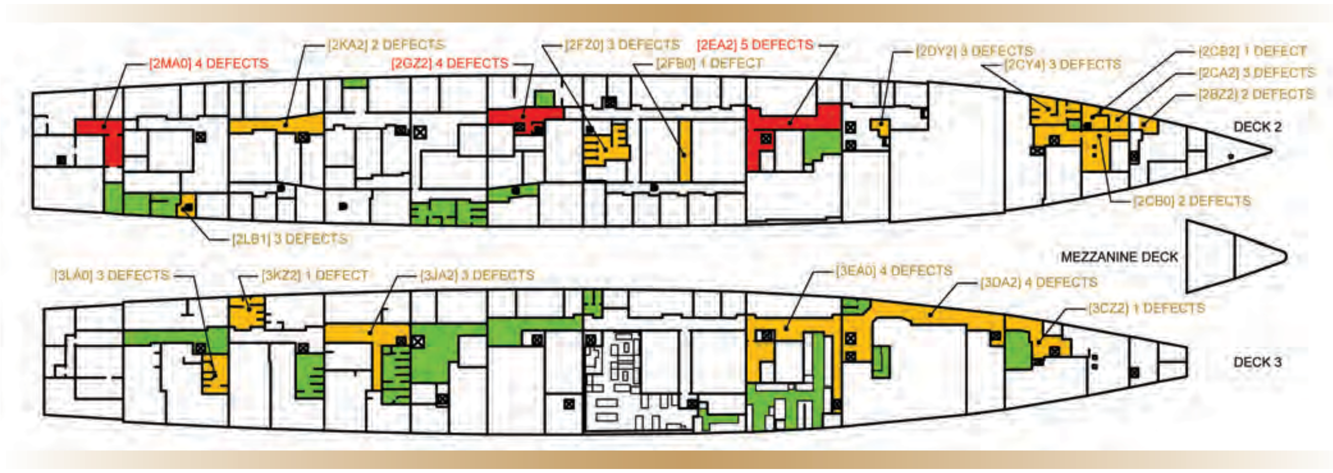



Figure 8. An example of a deck survey heat map showing the frequency and location of defects.

Prior to the start of the IDWPs, NETE personnel met with FMFCS NAO staff to finalize the PEC scan schedule, identify the highest priorities, and coordinate the work and reporting. Having NETE personnel available to conduct the targeted exterior PEC scans on the underwater hulls greatly improved the capabilities of the survey work. Upon finding an indication of a defect, NETE would inform the FMFCS NDT technicians who would conduct a UT inspection to either verify it, or eliminate it as a false positive. If the existence of a defect was verified, hull inspectors would complete a survey inside the vessel to determine its full scope and severity. Although no equipment removals were necessary to complete the pre-IDWP scans, it was clear that the PEC/UT examination process could easily reduce the time required for equipment removals in the way of follow-up inspections.

While PEC scanning of hull plating for corrosion-related material loss has shown real promise in detecting problem areas, there are limitations that must be acknowledged to ensure the technique is properly employed. PEC can produce erroneous readings due to weld material build-up (WMBU) repairs, previous hot work, or if the analysis team is unaware that small insert plates have been installed. In addition, defects in close proximity to structural members, such as frames and longitudinals, may appear more or less severe than reality, depending on compounding factors of the steel mass of the member and the particulars of the weld. Although the technique is not intended to provide information on the condition of the structure supporting the hull plating, the technique shows some promise in assessing the web of longitudinals and frames; however, further study is required.

## Conclusion

Pulsed eddy current testing should be considered a defect detection tool, rather than a measurement tool, whose purpose is to triage a component, and pinpoint areas of concern to target for closer examination. PEC narrows down the search area for follow-up ultrasonic testing and visual inspection requiring any removal of equipment or structure for access, while clearing those areas that do not require intervention. As such, it is recommended that PEC scanning be implemented in all future vessel docking periods to improve overall survey effectiveness, and allow more accurate development of DWP repair specifications.

As of September 2024, 11 frigates have had deck surveys completed, with a total of 467 compartments scanned. PEC has also been applied to multiple other platforms including the RCN's maritime coastal defence vessels, Orca-class training patrol vessels, and Canadian naval auxiliaries, as well as a number of Canadian Coast Guard vessels. Overall, NETE has completed more than 47 surveys encompassing 731 compartments.

This PEC scanning project is just one of many initiatives in the RCN's ongoing program to better manage and identify shipboard corrosion. With continued improvements, NETE and FMF aim to refine corrosion defect detection, workflow, and reporting. Furthermore, although a ship must currently be in dry dock to scan areas below the waterline, early-stage development is underway on a large array probe that can be operated by a robotic submersible platform for surveying the hulls of ships in the water.

FEATURE ARTICLE

# Future Tech: Is Quantum Radar a Promising Investment for the CAF?*

By Cdr Graham Hill, MSc, MDS

[*Adapted and updated from the author's 2021-2022 position paper written for the Joint Staff and Command Programme. Full references may be found at: https://www.cfc.forces.gc.ca/259/290/24/192/Hill.pdf]

In a lightly touching title reference to the *Sid Meier's Civilization* series of strategy games, militaries throughout history have often acted as catalysts for technological innovation. Innovations like gunpowder, radar, and GPS were all initially propelled by military needs. While the human cost of war is profound, its impact on technological advancement is undeniable, shaping the course of history and the trajectory of technological evolution.

In the naval environment, nothing has been more dominant for more than 70 years than a highly available radar system. But which future tech will take radar to the next level? Active electronically scanned array (AESA) systems such as the SPY-6 currently dominate the field, but quantum technologies, in particular quantum radar (QuDAR), could represent that next major step in advanced sensors.

To provide some background and adjunct reading, in February 2021, the Department of National Defence and Canadian Armed Forces (DND/CAF) released a strategy document relating to quantum science and technology (S&T), which was followed up by a more detailed strategy implementation plan in 2023. Both strategies acknowledge that quantum technologies will be disruptive to the future operating environment.

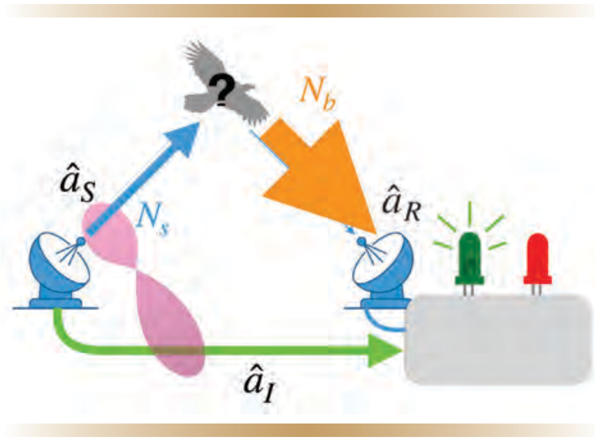
## Theoretical Background

The most basic theoretical principle behind QuDAR involves the generation of an entangled photon pair, also called quantum entanglement. These two entangled particles are more strongly connected than non-entangled particles used in current radars, and their quantum states remain more strongly linked across any distance than classical counterparts. In theory, when one particle is affected, it can be compared or correlated with its pair, and measurable properties such as position, spin momentum and polarization can be determined.

At its core, radar measures correlation between a transmitted signal and a replica of the transmitted signal. From a QuDAR perspective, an entangled signal provides a pair of photons, termed signal and idler, where the correlation between the signal and idler is much stronger than is possible using radar transmitters built with current technologies. QuDAR in development today (referred to as class 1), involves sending one of the paired photons toward a target, and retaining the second photon. The first photon, converted down from the visible light spectrum to microwave frequency via the radar transceiver, would be joined with the idler signal for comparison (Figure 1). According to a joint paper between the University of Waterloo's Institute for Quantum Computing (IQC), and Defence Research and Development Canada (DRDC) Radar Sensing and Exploitation group, a class 1 QuDAR can see detection improvements by a factor of 10, i.e. the required time on target to detect is one-tenth that of the best possible classical radar. This improvement factor can not only overcome interference such as clutter, jammers, and noise, but potentially even defeat stealth technology of modern military aircraft.

## Too good to be true?

Despite the promise of QuDAR and its potential for military applications, technological challenges and debate within the scientific community exist. A study done by the Massachusetts Institute of Technology (MIT) Lincoln Laboratory for the US Under Secretary of Defense for Research and Engineering, concluded the feasibility of quantum illumination radar (QIR) as having low potential. Specifically, they stated in their executive summary that "Quantum radar does not have the potential for long range standoff sensing (>10 km) at radio frequencies (<100 GHz)." Supporting their conclusions are key findings that system requirements (namely superconductivity) needed to realize quantum enhancements are a limiting factor, and that the integration time for a returning pulse could require up to three years of processing time. The Defense Science Board, an independent US Department of Defense (DoD) board of advisors, has also concluded that quantum radar "will not provide upgraded capability to the DoD." Despite these concerns, the US National Quantum Initiative Act




Credit: Quantum Circuit Group (Ecole Normale Supérieure de Lyon), from a paper published July 20, 2023 in Nature Physics (Nature Publishing Group – open access)

Figure 1. High-level diagram of a QuDAR system. The transmitted signal (âs) reflects off a target, after which the return signal (âr) joins the idler signal (âi) for comparison.

was signed into law on December 22, 2018, providing $1.2 billion (USD) to fund activities that promote and develop quantum information science.

Other organizations and emerging scientific literature seem to disagree with these conclusions. In a 2019 study for the Swedish Ministry of Defence, the Swedish Defence Research Agency concluded that QuDAR is based on solid and well-accepted physics, and has the potential to surpass its classical counterparts if a sufficient amount of research and engineering is put into the endeavour. Dr. Bhashyam Balaji from DRDC Ottawa comes to similar conclusions. While acknowledging that the cryogenic / superconductivity infrastructure needed to generate an entangled photon pair in the microwave frequency is currently a challenge for future real-world applications, he also concludes that "QIR can definitely be built … however, building a QIR will require a concerted and proper investment, which could result in some demanding and very important defence applications." In fact, several lab-based prototypes with verifiable results have already been developed in both Canada and Austria. China also claims to have deployed a system capable of operating up to 100 km (62 miles), but this has not been independently verified.

There are many technological routes to building a QuDAR, just as there are many ways to build a quantum computer. The most popular route today is based on working directly in the microwave regime. However, this approach requires demanding cryogenics in the form of dilution refrigeration to allow operation in the milli-kelvin temperature range. Cryogenics is clearly unsuitable for materiel fielding by armed forces in the short term.

Another more promising approach would be to carry out optical-to-microwave photon conversion. Although this is currently at a lower technological readiness level, it would lead to considerably more compact QuDARs. As a point of comparison, the first mobile phones were roughly the size of a briefcase, and are now only limited in size by the anatomy of the human hand. Miniaturization will undoubtably solve these infrastructure issues, as long as the theoretical application of the technology in warfare is built upon strong scientific concepts.

## The Promise

In a comprehensive article for the *Journal of Electronic Defense,* senior editor John Haystead concludes that QuDAR "… is one of the most significant technologies being pursued for military application, with the potential to supersede stealth in terms of its impact on the battlespace." To come to this conclusion, he interviewed scientists closest to the technology from IQC, Lockheed Martin, and DRDC. They conclude that QuDAR would be uniquely effective for detecting low-reflectivity targets against a high-noise background. For stealth objects like aircraft, which strive to reduce their radar cross-section with curved surfaces and radar-absorbing materials, quantum enhancements of traditional radar systems could make them more easily detectable. This includes correlating transmitted photons against those which were retained after the quantum entanglement process; resulting in reflected energy being better distinguished from background noise and interference. This improvement in signal-to-noise ratio (SNR) for returns would also by extension increase a radar's maximum detection range. Improving SNR by a factor of four or six dB, which is a conservative estimate for QIR, would mean an increase in range of approximately 40 percent.

The advantage of stealth in the aerospace domain, which extends to both the maritime and land environments, has been significant to western militaries. F-117 Nighthawk aircraft were the first to bomb Baghdad during Desert Storm, eluding enemy radars and delivering laser-guided bombs with precision. The F-15 Eagle, one of the most dominant fighters in history, has a radar cross-section several orders of magnitude greater than that of an F-35 Lightning II. The F-15 as a result can be detected more than 322 km (200 miles) out with modern radars. The F-35, on the other hand, can get within 34 km (21 miles) before it is detected. This advantage which has been enjoyed by the US and its allies for the last 30 years will not last.

*(Continues next page...)*

## The threat we currently face

The Russians and Chinese have both fielded stealth aircraft over the last decade. The Russians have the Su-57 which entered service in December 2020. The Chinese are even farther ahead with their now operational J-20. The Chinese J-31 aircraft, which has a similar profile to the F-35, could also soon be ready for mass production. QuDAR therefore represents a burgeoning technology that could provide a means of detecting these newly developed stealth fighters and bombers of our adversaries. With North American Aerospace Defense Command (NORAD) modernization now a priority for both Canada and the US, investing in a QuDAR capability also represents an opportunity to limit or outright defeat potential future intrusions by new Russian and Chinese stealth aircraft.

In the 2021 US Annual Threat Assessment, China's push for global power is listed as the leading threat to US national security. In line with this report, its past and current substantial investments in quantum technologies should also serve as a wake-up call to not just the US, but to Canada as well. In 2017, China announced an investment of $10 billion (USD) to develop and build the National Laboratory for Quantum Information Sciences (NLQIS), following the launch of the first quantum communication satellite by China just a year earlier. A Chinese defence contractor has also claimed to have successfully developed the world's first quantum radar system, unveiling it at the Zhuhai Airshow in China in November 2018. Despite the inability to verify the claim regarding the development of a functional QuDAR, it is clear that China is leading the way in quantum technology breakthroughs, under the leadership of Jian-Wei Pan, referred to as "the father of quantum."

Jian-Wei Pan has deep political, academic, and even military connections. While his scientific achievements and academic partnerships are well known in western circles, his links to the Chinese Communist Party and Chinese defence companies are less publicized. An intelligence dossier produced by Strider Technologies, a Washington-based security company, detailed the extent of the collaboration through publicly available Chinese-language documents. One of the most interesting connections was that Pan signed a 2018 cooperation agreement between his university, the University of Science and Technology of China, which houses the NLQIS, and China Electronics Technology Group Corporation (CETC). CETC is a large state-owned defence contractor, and coincidentally, the firm that unveiled China's first QuDAR in 2018. Due to China's national security law, it should come as no surprise that any academic progress with quantum technologies

DND/CAF documents relating to quantum science and technology.

will be passed over to the defence and military establishments. Western collaboration with Chinese scientists must therefore be heavily scrutinized, especially if the research could lead to military applications. A 2019 United States Senate report to the Committee on Homeland Security explored this very threat, and describes how American taxpayers have funded research that has contributed to China's global rise. Most disturbingly, it concluded that "China unfairly uses the American research and expertise it obtains for its own economic, and military gain" through its national strategy known as military-civil fusion.

## The Bottom Line – Should the CAF/RCN invest in QuDAR?

While QuDAR remains a new subject of research, experimentation in the microwave domain is accelerating and at least two verified laboratory prototypes have been developed to date. By utilizing the principle of quantum entanglement, the potential military applications of QuDAR are difficult to ignore. These potential advantages include the defeat of stealth, and the development of low-probability-of-intercept radars which could usher in a new era of detection supremacy amongst western nations. The augmentation of traditional radar systems, would also not negate their original capabilities. This differs from both quantum computing and communication, where the entire technology stream is built upon the entanglement principle.

The development of countermeasures against QuDAR would also prove difficult, if not impossible without our own continued investment in the technology. The very low transmitted power from a QuDAR means that traditional jamming methods such as barrage jamming or home-on-jam would be relatively ineffective as the transmitted signal could operate at, or below the noise threshold.

Canada is currently a world leader in quantum initiatives, centred around the IQC (Figure 2), l'Institut quantique de l'Université de Sherbrooke, DRDC Ottawa, the National Research Council, and internationally renowned quantum computing companies such as D-Wave, 1Qbit, and Xanadu. It is also home to Qubic, the world's first microwave QuDAR company that spun out of research carried out at the ICQ on the world's first microwave QuDAR experiment that attracted international attention. If we are to continue to hold this advantage and keep pace with our adversaries, a deepening of ties between industry, academia, and defence must be seriously pursued. While the DND/CAF quantum S&T strategy and implementation plan is a positive first step, sustainable and long-term funding, as well as robust security measures must be enacted. Funding by government will allow clients, such as the CAF to shape and advise the R&D program, including the building and testing of QuDAR prototypes which will be relevant in future conflicts. Security protocols, along with the screening of those participating in projects, will ensure the protection of Canadian intellectual property (IP), and foster the talent and creation of new industries in this niche field of study.

So, in short, yes. Based on the future threats we face, and the level of interest our adversaries are paying to quantum technologies writ large, ignoring and not investing in quantum radar prototypes would be undesirable. We need to better understand the technology and how to defeat it, or otherwise we put at risk current Canadian investments and projects, such as the Remotely Piloted Aircraft System, the Future Fighter Capability Project, or dare I say the River Class Destroyer Project. This can best be accomplished by improving the visibility and priority of the DND/CAF S&T investment streams, which are currently concentrated through the various commands involved in force generation—namely, the Royal Canadian Navy, Royal Canadian Air Force, Canadian Army, and Canadian Special Operations Forces Command (CANSOFCOM). As famously stated by Sun Tzu, "Victorious warriors win first and then go to war, while defeated warriors go to war first and then seek to win."

*Cdr Graham Hill is the Senior Security and Integrated Data Environment Manager for the River Class Destroyer Project in Ottawa.*

## Acknowledgment

My thanks to Dr. Bhashyam Balaji of DRDC for his continued engagement and work in quantum technologies for the department.

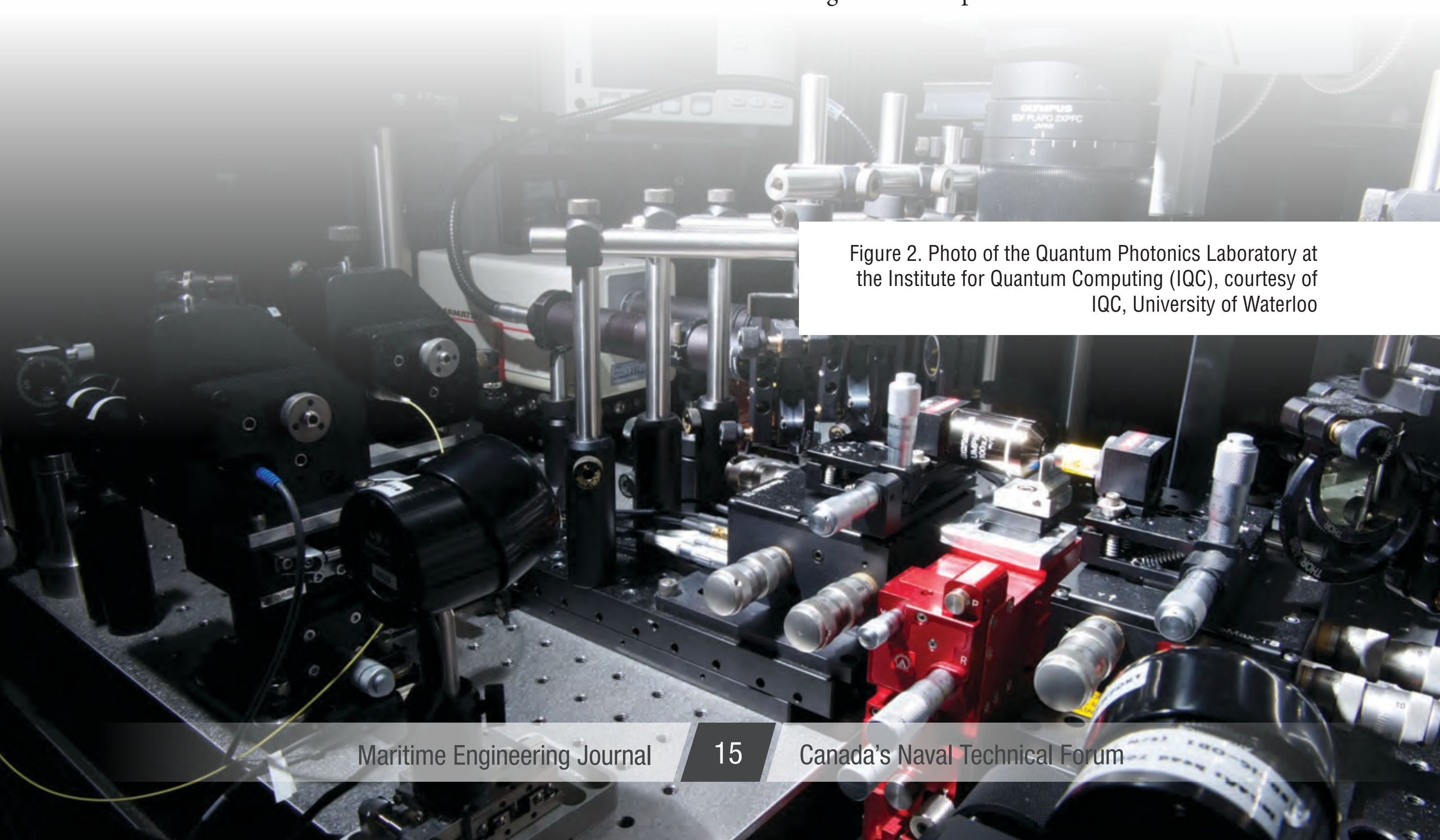


Figure 2. Photo of the Quantum Photonics Laboratory at the Institute for Quantum Computing (IQC), courtesy of IQC, University of Waterloo

FEATURE ARTICLE

# Schedule Risk Analysis – A Best Practice in Managing Complex Defence Procurement

By Jonathan Shriqui, PMP

One of the greatest paradoxes, or perhaps ironies, in the Canadian defence domain is that in the field of operations it is vital to adapt to a changing threat environment, whereas our rules of engagement for defence *procurement* appear to be set in stone. The effects of the latter, it can be argued, contribute in part to the historical delays in Canadian defence project delivery.

In January 2022, in light of the security situation in the Indo-Pacific region and other emerging threats, the House of Commons Standing Committee on National Defence adopted a motion to study the Canadian Armed Forces' (CAF) operational readiness to meet these threats. A month later, the war in Ukraine broke out, and later that year the Committee released its *Interim Report on the Defence of Canada in a Rapidly Changing Threat Environment*.

The report highlighted that, "our [Canada's] approach to addressing Defence modernization is taking far too long to produce any useful results."[1] Unsurprisingly, the Committee recommended that the Government of Canada reform defence procurement processes to ensure that major weapon systems and military equipment are delivered to the CAF more expeditiously.

As part of its response, the Department of National Defence (DND) referred to its strategic initiatives of earned value management (EVM – see *MEJ* 108) and risk-based scheduling (also known as three-point estimating) which seek to improve project planning and execution. These initiatives were initially rolled out in the 2021-2022 Department of National Defence and Canadian Armed Forces Departmental Plan[2], and have been sustained ever since.

EVM and risk-based scheduling are distinct but complementary project management best practices. The first enables an unbiased and auditable assessment of a project's performance and progress using a series of metrics against an integrated cost and schedule baseline. The latter is a process that helps ensure a project's schedule accounts for a reasonable level of risk, with the purpose of implementing a realistic and achievable timeline for a project's execution.

The question, then, is how is a reasonable level of risk determined for complex defence procurement? How does one plan for risks relating to technology readiness, anticipated learning curves, and decision delays?

We go back to basics. As countless military leaders have learned in the heat of battle, rigid, premade plans are often useless. It is the practice of developing plans, and backup plans, and exploring all options that is of the greatest value. The ability to continuously adapt to changing circumstances is what allows leaders to overcome obstacles and achieve success in the field. Heavyweight boxer Mike Tyson summed up this notion rather succinctly when he said, "Everyone has a plan 'till they get punched in the mouth."

In the present context, the "field of conflict" for leaders tasked with procuring complex military systems is undoubtedly the project's schedule, as new capabilities are always needed "yesterday." And yet, they face the most fickle adversary of all—time. In project management, the art of wielding time is known as schedule management, a discipline that is often misunderstood and undervalued. For the untrained, particularly those supporting complex procurements, it is a discipline in which calamity will inevitably reveal itself without remorse.

A master scheduler is not a driver of tasks within a Gantt chart, but a maestro who orchestrates a project using specialized project management (PM) instruments such as the statement of work (SoW), the work breakdown structure (WBS), the basis of estimates (BoEs), and the risk register to establish a baseline schedule. As such, the scheduler sets the stage for such follow-on activities such as the integrated baseline review (IBR), EVM reporting, and cash-flow forecasting.

Typically, a project's capacity to manage the schedule impact of risk variability is assessed by performing what is known as a schedule risk analysis (SRA). The concept and benefits of an SRA have long been known, and are found in the literatures of the Project Management Institute (PMI), the Planning and Scheduling Excellence Guide from the National Defense Industrial Association (an affiliate of the

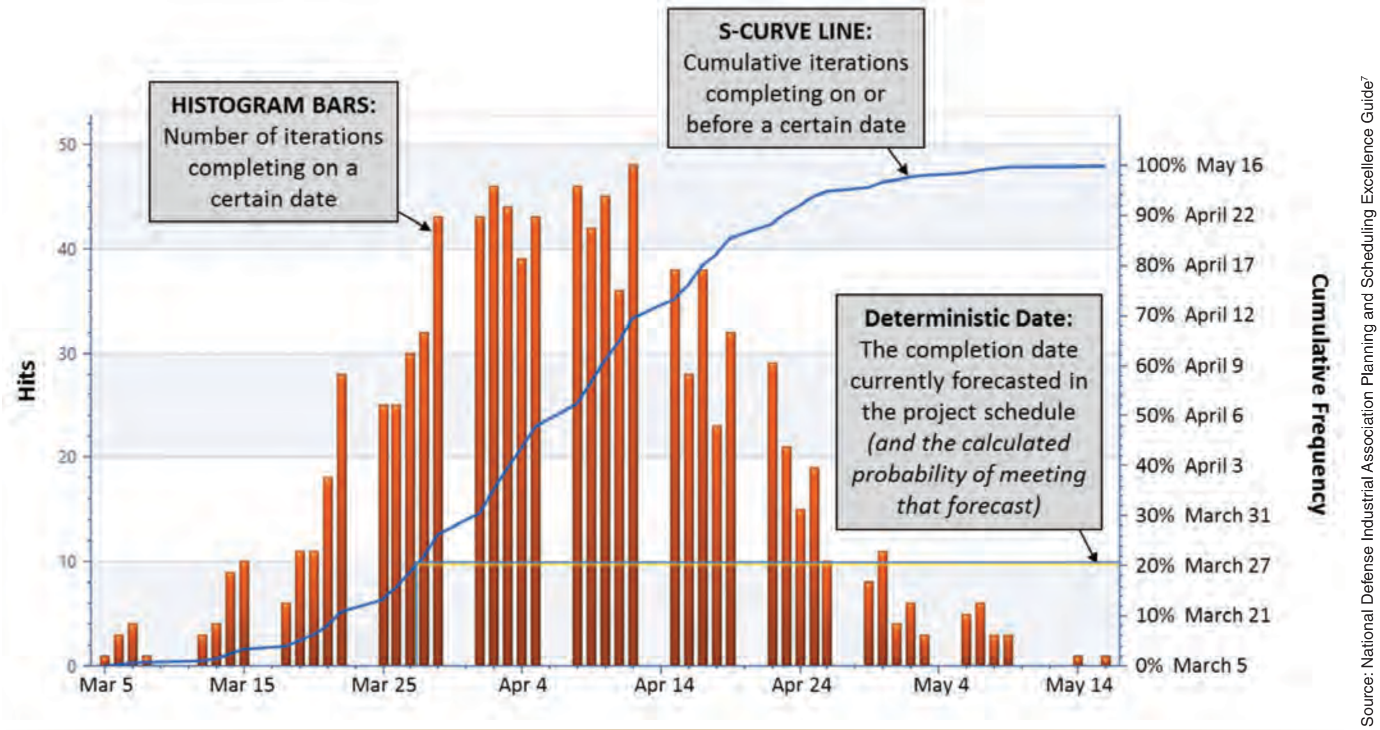



Figure 1. Schedule risk assessment sample output based on Monte Carlo probability analysis.[1]

Canadian Association of Defence and Securities Industries (CADSI)), and in the Defence Research and Development Canada (DRDC) paper on *Schedule Risk Analysis for Defence Acquisition Projects*[3] *(2016)*. DRDC would later reiterate the importance of an SRA in their paper on *Risk Analysis of Defence Acquisition Projects*[4] *(2017)*.

For the sake of brevity, an SRA may be broken down into two main tasks: verification and simulation: **Verification** seeks to confirm a schedule's architecture for completeness (i.e. *Is all scope present? Is the architecture of the work breakdown structure appropriate?*), as well as its ability to respond dynamically to change (i.e. *Is the schedule's logic sound?*). **Simulation** typically consists of using a software-driven Monte Carlo probability analysis to produce a probabilistic assessment of the schedule's outcome. This is achieved by assigning both positive (i.e. *optimistic*) and negative (i.e. *pessimistic*) risk factors to the *originally estimated durations* of the schedule's activities; hence the term, three-point estimate (Figure 1).

A project's focus is, or should be, driven by its schedule's critical path, the shortest possible duration to complete the project. However, it is not uncommon for complex procurements to have many critical paths, and many near-critical paths. This is where computer simulations can provide significant benefits. By applying risk factors to all activities and running probabilistic simulations, stakeholders have better understanding of the impact of identified risks on a schedule's duration even if the project does not follow the intended path. This also justifies why an SRA should not be limited to the activities on the critical path, particularly on large and complex procurements.

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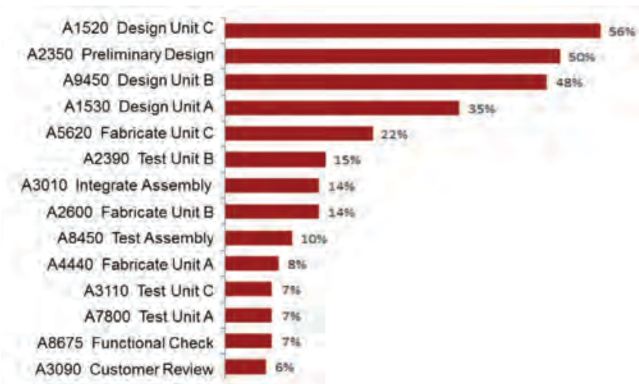


Figure 2. Schedule risk assessment sensitivity analysis sample output.[7]

| Task Name | Criticality Index |
|---|---|
| Complete HW & SW Final Integration | 75% |
| Conduct Final Integration Check-Out | 70% |
| Perform Final System Verification | 60% |
| Write Final Check-Out Test Plan | 30% |
| Write Final Check-Out Test Procedures | 20% |
| Assess & Resolve Final Results | 15% |

Figure 3. Schedule risk assessment criticality index sample output.[7]

Most SRA software will typically output a sensitivity analysis (also known as a tornado chart), and a criticality index to accompany the risk histogram. The sensitivity analysis (Figure 2) will reveal which activities had the most impact on the probabilistic outcome. These are activities that, when affected by risk, have the most impact on the schedule's duration, and would likely benefit the most from early risk mitigation. The criticality index (Figure 3) reveals how often an activity was on the critical path throughout the simulation. Activities on the critical path, if delayed, will typically extend the schedule's duration independently of risk occurrence.

Using these outputs, project stakeholders can obtain insight into the realism of the project's deterministic plan (i.e. the schedule), and more importantly gain awareness into which activities are most likely to be delay drivers. The quintessential purpose of an SRA is not to risk-assess the plan itself, but to facilitate the act of planning and enable the project manager to choose the best way forward on an unpredictable path. For an SRA to be effective, credible, and decision-worthy, the perception and impact of risk need to be shared, accepted, and understood by all stakeholders. However, by its very nature, risk is capricious. The issue lies not with how an SRA is performed, or by whom, but rather "*with whom*," or, more accurately, "*without whom*."

Students of the Complex Project & Procurement Leadership program from the Telfer School of Management are taught that the primary driver of complexity is aligning various stakeholder interests to achieve a common outcome. "*Engage early, engage often*" is one of the course mantras.

For a moment, contemplate that as part of the request for proposal (RFP) process DND required Industry bidders to participate independently in a DND-led SRA exercise. Such an exercise would not only reinforce the need to proactively identify potential risks, but more importantly would allow each party to share their perception of the impact of those risks in a quantitative and measurable manner. It is unlikely that such discussions would always be comfortable, but early engagement into difficult conversations is a key step in the pursuit of aligning objectives, interests, and most importantly in forging new relationships.

Ultimately, this exercise would culminate with bidders submitting their own independent SRA as part of their bid proposal, which in turn would become part of the evaluation process. Following contract award, this joint exercise should be repeated as necessary throughout the project's execution and, at a bare minimum, mandated as an exit criteria requirement of any major project milestone until the project's residual risk is within the accepted tolerance level. Repeating this process will enable all parties to either agree to a shared assessment of risk, or expose areas of misalignment. In either case, particularly in the latter, risk awareness is heightened.

This concept of engaging both Industry and Government to jointly perform an SRA is considered by many subject matter experts to be best practice for the defence industry.

In 2020, DND received a project management SOW template from the US Defense Contract Management Agency, the US DoD's procurement arm, which included requirements for an SRA:

> The prime will participate in Government-conducted quarterly probabilistic Schedule Risk Assessments (SRA). [ … ] The contractor shall report optimistic, pessimistic, and most likely remaining durations and rationale for […] each task/activity on any of the following paths: critical path to Program Completion, critical path to the next Major Milestone, and the next three near critical paths to the next Major Milestone.

The US DoD updated their contract data requirements list (CDRL) template a year later to include requirements for contractors to, among other points, "perform and report the results of additional SRAs"[5] as directed by the government.

Would this approach ensure that all projects are delivered on time? Likely not, but it is a proactive first step in narrowing down the variability in project timelines. Additionally, it could also serve as historical input for PSPC's new Vendor Performance Management Policy[6] which accounts for schedule performance.

SRAs are not without their faults. They have the potential to needlessly extend a project's schedule duration. This would be particularly true for an organization that has a low tolerance for risk, or is prone to favour risk avoidance over a practicable approach to risk management. As previously described, an SRA requires three data points covering the *optimistic*, *pessimistic* and *most likely* risk factors. If the pessimistic factors are too risk-averse, or subject to too great a negative bias, the statistical model is likely to result in an over-extended schedule. Given that time is money, this inevitability translates into an inflated project cost. This negative impact can be compounded if a project's schedule is required to have too high a probabilistic outcome (i.e. > 85%) for on-time delivery. This would result in echoing the effects of risk-aversion and negative bias, thereby compounding the effect. Consequently, risk-averse decision-makers would likely reject the project due to ballooned costs and extended schedule estimates. Nevertheless, an SRA can be used to incentivize bidders to submit more realistic project timelines during proposal submissions.

Conversely, a model could be affected by risk factors that are too optimistic. In this case, the effect is delayed. The project is approved, but soon enough steers off course due to risks being realized. Depending on the priority of the project in the organization's portfolio, either capability must be reduced to meet schedule and cost objectives, or other projects in the portfolio must be delayed or cancelled to respect the enterprise's funding envelope. However, the true impact occurs when the ripple effect on related underlying projects such as training and infrastructure projects occurs.

While the risks of inaction due to aversion or low risk tolerance are not without consequences, they are typically more foreseeable than the risk impacts due to the zeal usually associated with risk optimism.

Joint participation by Canada and Industry in regular SRA exercises throughout a project's execution is not only a sound approach to schedule management, but also an enabler of a better practise of risk management founded on stakeholder engagement. To leadership, the output of an SRA should be more than mere charts and data. It is a representation of cooperation. On complex and large procurements, managing risks is undoubtedly the name of the game, and those who control risks shall master schedule and cost.

In 2023, DND's Directorate of Project Management Support Organization (DPMSO) acquired Deltek's Acumen, a leading software with SRA capabilities. In time, this capability has the potential to change how DND perceives risk and how decisions are made, thereby better supporting the military personnel serving on Canada's front lines by delivering defence projects in a more timely manner.

*Jonathan Shriqui is the Project Control Officer for the Future Aircrew Training program in Ottawa.*

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## Submissions to the *Journal*

**The *Journal* welcomes unclassified submissions in English or French. To avoid duplication of effort and ensure suitability of subject matter, contributors are asked to first contact the production editor at MEJ.Submissions@gmail.com.**

# Title of Interest


**The Silent Service's First Hero: The First Submariner to Receive the Medal of Honor**

By Ryan C Walker

Published (2024) by Pen & Sword Maritime
www.pen-and-sword.co.uk
ISBN: 9781036100414
Hard cover, 232 pages, 15 mono illustrations


Library of Congress Photograph, 2016848189

Don't let the title of this book fool you. It is not "merely" the story of an American submariner who attained a great honour because of a heroic deed. It is also about a sailor of Canadian descent who joined a unique Canadian naval reserve unit, served on board one of Canada's first warships, and is believed to have assisted with the Halifax Explosion rescue efforts — all before becoming a submariner in the United States Navy, and being awarded the US military's highest decoration for valour, the (Congressional) Medal of Honor.

*The Silent Service's First Hero* is the story of **Torpedoman's Mate Second Class (TM2) Henry Breault** (1900-1941), and comes 100 years after he received his Medal of Honor from President Calvin Coolidge on March 8, 1924 (see photo). The award was made in recognition of the young sailor's actions five months earlier aboard the U.S. Submarine O-5 (66) in the northern approaches to the Panama Canal:

> On the morning of 28 October 1923, the O-5 collided with the steamship *Abangarez* and sank in less than a minute. When the collision occurred, Breault was in the torpedo room. Upon reaching the hatch, he saw that the boat was rapidly sinking. Instead of jumping overboard to save his own life, he returned to the torpedo room to the rescue of a shipmate whom he knew was trapped in the boat, closing the torpedo-room hatch on himself. Breault and (Chief Electrician's Mate Lawrence T.) Brown remained trapped in this compartment until rescued by the salvage party 31 hours later.

The particulars of this event are described in more gripping detail in the book. Breault became the first submariner in USN history to receive the Medal of Honor, and remains the only enlisted sailor to receive the Medal of Honor for heroism while serving as a submariner.

Library of Congress Photograph, 2016836981

Author Ryan C. Walker, a former fire-control technician in the United States Navy, dives into pre-Second World War submarine history through this first comprehensive, analytical, investigation into the life and times of Henry Breault. From 1900 to 1941, Breault's life is reconstructed as lived through his military files, census records, and newspaper clippings, while connecting previous research. Breault's childhood beginnings with his emigrated French-Canadian family in Putnam, Connecticut, to his enlistments in the Royal Naval Canadian Volunteer Reserve and United States Navy are carefully reconstructed.

From there, the conditions aboard the submarines he served on, his relationship with friends and family, allow us to better understand his life in the context he likely understood them. This book is touted as a new template for micro-historical observations into subjects whose primary sources are official military documentation.

There are aspects of this book that are fascinating from a Canadian naval history perspective. Breault enlisted through the Royal Naval Canadian Volunteer Reserve (RNCVR) which was established in Canada from 1914 to 1923, and was the precursor to the more familiar Royal Canadian Naval Volunteer Reserve (RCNVR). Breault was posted to HMCS *Niobe*, one of the first two Royal Canadian Navy ships at the time. By the time Breault signed up in 1916, *Niobe* was permanently tied up alongside Halifax dockyard as an accommodation depot ship. Barely five months in the Navy, Breault was on board *Niobe* during the Dec. 6, 1917 Halifax Explosion, and is reported to have participated in the rescue efforts. Walker surmises that this experience may have influenced Breault's selfless actions later in his career.

Henry Breault died of heart failure in a U.S. Navy hospital in Rhode Island on Dec. 5, 1941, two days before the attack on Pearl Harbor that brought the United States into the Second World War.

# News Briefs

## FMF Cape Breton – The West Coast AJISS Enterprise

By Ryan Solomon, Greg Lewis and Sebastien Richard

The West Coast "AJISS" enterprise achieved a critical milestone with the completion of its first short work period on HMCS *Max Bernays* (AOPV-432) through May and into early June. AJISS, or the Arctic Offshore Patrol Vessel and Joint Support Ship In-Service Support Contract, forms a collaborative enterprise of the Maritime Equipment Program Management directorate, Thales, the Fleet Maintenance Facilities, and several technical support networks with a common vision to provide world-class naval technical service delivery to maintain these new classes of ships. Through this relational contract, a first of its kind for the RCN, and designed to maximize performance through flexible partnerships based on common behavioural principles, the enterprise worked to successfully deliver more than 350 maintenance/engineering tasks through an integrated schedule.

It is a complicated arrangement to bring the various stakeholders together and coordinate the execution of hundreds of tasks, yet all the scheduled work was achieved without a single safety incident. These efforts also incorporated the essential certification tasks and engineering changes to enable *Max Bernays* to conduct daytime "SWOAD" (i.e. ship without air detachment) operations, a necessary step toward full air capability, and a first for the *Harry DeWolf*-class AOPVs.

The work period was certainly not without its challenges, as the team worked closely together to solve several arising problems, and address a number of unforecasted repairs.

Photo by Corporal Will Gosse, MARPAC Imaging

Petty Officer Second Class Mayer, a Marine Technician aboard His Majesty's Canadian Ship *Max Bernays* assists in landing a CH-148 Cyclone on the ship's flight deck during a Ship Without Air Detachment scenario on June 18, 2024 in the Pacific Ocean.

Perseverance and good communication allowed the team to deliver the mutual objectives that underpin the AJISS mission: i.e. to provide materiel-ready ships to the RCN on time, every time. These efforts were noticed nationally, with the Director General Maritime Equipment Program Management, **Cmdre Keith Coffen**, noting that this was the model of collaboration for service delivery the RCN had hoped to see with AJISS. This outstanding achievement for the West Coast enterprise was thanks to all the personnel who worked to plan, schedule, manage, support and execute the work on board *Max Bernays* as one team.

# News Briefs

## Changes of Command at Fleet Maintenance Facilities Cape Scott and Cape Breton


Photo by MCpl Jaclyn Buell, MARLANT Formation Imaging Services

On July 17, 2024, **Capt(N) Eric McCallum** assumed command of FMFCS from outgoing CO **Capt(N) Jonathan Lafontaine** during a ceremony held at His Majesty's Canadian Dockyard in Halifax, Nova Scotia. **RAdm Josée Kurtz**, Commander Maritime Forces Atlantic, presided over the proceedings.

Photo by Sgt Malcolm Byers, MARPAC Formation Imaging Services

On July 19, 2024, **Capt(N) David Roberge** assumed command of FMFCB from **Cdr Iain Meredith** during a Change of Command ceremony held at His Majesty's Canadian Dockyard in Esquimalt, British Columbia. **RAdm Christopher Robinson**, Commander Maritime Forces Pacific, officiated over the ceremony.

## A New "Old" Look for the Canadian Naval Memorial Trust

By Ann Mech

In 2023, the Board of Directors of the Canadian Naval Memorial Trust (CNMT) embarked on the development of a strategic plan. While for the past 40 years the Trust has been a diligent steward of HMCS *Sackville*, the last wartime corvette in existence, the ship faces a number of challenges including the eventual replacement of the hull. The year-long effort to establish strategic priorities culminated in a renewed mission to preserve HMCS *Sackville* to help generations of Canadians appreciate the accomplishments and sacrifices of the Royal Canadian Navy during the Second World War.

The requirement for a clear brand that would encapsulate the goals of the Trust was evident. With this in mind, the CNMT's Branding Committee hired a marketing contractor to articulate the Trust's requirements, including specifications of key target audiences. These clarifications led to the hiring of an advertising agency to create a brand campaign. Their output was completely on target. The resulting print and audio-visual ads function as "storytelling moments," explaining how the seemingly small elements in sailors' lives were instrumental in changing the course of history. Each ad ends with the tagline: "And that changed everything."

The work and purpose of CNMT are summed up by another tagline: "History preserved is history remembered."

The Trust's logo, along with its specific colours, were modernized with reference to dazzle paint and fonts reminiscent of the 1940s. An advertising campaign was introduced on television, as well as on Amazon Prime, podcasts, on-line digital ads, and through social media. The branding campaign continues to roll out with a renewed website, signage, print ads, and even stationery.

The rebranding of the Canadian Naval Memorial Trust lays the foundation to attract new trustees, and promote fundraising to help preserve the ship and share its stories for years to come.

PRESERVING CANADA'S NAVAL TECHNICAL HERITAGE

CNTHA

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**www.cntha.ca**

## Selection of the 3"/50-cal. Gun Mount Fitted Aboard HMC Ships *Protecteur* (1) & *Preserver* (2) 60 Years Ago

By Pat Barnhouse

During the summer of 1964, as a brand-new lieutenant commander, I was posted to the Directorate of Systems Engineering (DSEng), an outlier of Director General Fighting Equipment. In short order, I became directly involved in selecting gun armament for the RCN's two new *Protecteur*-class AOR oiler replenishment ships that would begin construction at Saint John, NB in 1967. Things rarely move in a straight line when specifying ship equipment, and how these ships ended up with a twin 3"/50-cal. gun mount, let alone a gun system at all, was proof of that.

At the time, much of the Navy's ship design work was done in-house. This was the case with the preliminary design for *Protecteur* (AOR-509) and *Preserver* (AOR-510) using Operational Sequence Diagrams that would define the relationship between functions, equipment and personnel to help lay out the class arrangement for the two ships. The Navy also had a "living example" of an AOR available for reference. HMCS *Provider* (AOR-508) had joined the fleet just a year earlier, and study of this ship revealed many areas that could be improved upon in the new builds.

*Provider*'s commanding officer, **Capt(N) Kai Boggild**, was invited to Ottawa to share his thoughts from an operational viewpoint, and while much of what he offered had already been considered, there was one item that was apparently not yet in the mix: AORs were warships, he contended, and should therefore have a gun. The captain opined that a Chinese junk (a type of sailing vessel) could come alongside and blow him out of the water, and so the saga of the AOR bow gun was born. There were stories, possibly apocryphal, that fitting the new AORs with guns would qualify them for some kind of reduced "warship tariff" when transiting the Panama Canal, but whether this was indeed the case remains unsubstantiated as far as I know.

US Navy photo

Photo courtesy ReadyAyeReady.com

The AOR 3"/50-cal. gun in different eras. At top, aboard *Preserver* in the 1970s, and reinstalled aboard *Protecteur* at bottom for Op Friction in 1990.

The direction duly came down to me with instructions to choose a gun and decide where to fit it, bearing in mind that the chosen weapon would have to rely on local operation, without any associated fire-control system. To me, it seemed sensible to repurpose a couple of the 4"/45-cal. guns that were coming off our decommissioned wartime destroyers and *Prestonian*-class frigates. The mounts required a large eight-man crew to serve them, it was true, but this would be offset by their simplicity of operation in that they could be laid and trained right at the mount itself. I suggested this to the Naval Staff, but had to look elsewhere when they pointed out that although there were lots of four-inch mounts available, there was no plan to buy ammunition for them.

It was a similar story with my next suggestion to fit a couple of the RCN's Hazemeyer mounts for the 40-mm Bofors that were being taken out of service. HMCS *Ontario* (C53/32) had carried such guns, and

*(Continues next page...)*

Photo courtesy Naval Museum of Halifax Collection

A close-up view of a twin 3”/50-cal. gun mount. This unit from the decommissioned HMCS *St. Croix* (DDE-256) is on display at the CFB Halifax Naval Museum. The AOR guns were not fitted with the fire-control radar dish shown here, so had to be operated in local mode.

I had seen them fired to great effect—but once again, I was told that ammunition would be unavailable. (Six or seven years later, I was surprised to see these same weapons being shipped out of the Naval Armament Depot in Dartmouth, NS, destined to become interim air-defence installations at our airfields in Germany. When I asked about ammunition, I was told there was plenty available.)

I was left with one last suggestion—the twin 3”/50 mounts coming off the quarterdecks of the *St. Laurent*-class destroyers that were being converted to DDHs. The Navy agreed.

It then came down to choosing a location for the gun. Having seen several USN auxiliaries with sponsons around the aft end, I suggested the same arrangement. This was greeted with horror by the naval air community who wanted the entire stern area of the two ships kept inviolate for helicopter operations. Nothing was to interfere with this. There was no way the gun could be fitted amidships, as this area was devoted to liquid and solid replenishment stations. I then suggested an apparently vacant area just forward of the bridge house, only to be told that this was reserved for a proposed single-arm Canadian Sea Sparrow missile launcher system (which was cancelled in late 1973 or early 1974, and never fitted).

There was only one place left to put the 3”/50, and that was right up forward, clear of the anchor cables and handling gear. Over the years, this turned out to be a less than happy choice. **Capt(N) Robin Allen**, who was CO of HMCS *Preserver* from 1991 to 1993, recalls that his ship’s gun had been removed in 1984 due to its exposed position so far forward leaving it vulnerable to the effects of weather and wave action over the bow. In fact, numerous gun shields were destroyed. Investigation in the late 1970s showed that large seas coming in over the bow would fill the zeriba—the corral surrounding the gun mount designed to trap spent casings—and force great quantities of water up through the open bottom of the enclosure shield, exploding it from the inside out.

In the end, the 3”/50 guns that had been so carefully specified proved to be more trouble than they were worth, and were removed from the two AORs in the mid-1980s. In an interesting footnote to this story, when HMCS *Protecteur* sailed from Halifax on August 24, 1990 with the Canadian naval task group bound for the Persian Gulf during Op Friction, the gun was back in place.

*CNTHA Chairman Pat Barnhouse retired from the Navy as a Combat Systems Engineering Commander in 1989.*

Photo by Brian McCullough