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Members from Maritime Atlantic and 12 Wing Shearwater take part in the 80th Anniversary of the Battle of the Atlantic Parade at Point Pleasant Park in Halifax, Nova Scotia on May 4th.

Photo courtesy Corporal Mitchell Paquette

Director General Maritime Equipment Program Management

Commodore Keith Coffen, CD

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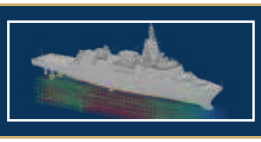

A simulation of results of an underwater threat grid, with the colours reflecting the modeled Probability of Escaping Critical Damage.

Image courtesy of Survivability Consulting Ltd.

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COMMODORE'S CORNER

Three Key Messages

By Commodore Keith Coffen, CD

Three years has passed quickly, and this is my last Commodore's Corner as DGMEPM. Unlike most of my predecessors who have generally served a tour or two past this job before retiring to the National Capital Region (NCR) and points west, my path will most likely be different. As an Atlantic-Canadian couple with no family connection to the NCR and changing family circumstances, my wife Jacqueline and I reached a decision last year to return to Halifax in 2025. While this is the best overall solution to support the evolving needs of our remaining parents and the rest of our family, the move presents challenges to continued service, and a transition is all but inevitable. We are not the first family to arrive at this juncture, and we certainly will not be the last. As it is often said, you can take the sailor out of uniform, but you can't take the uniform out of the sailor. Whatever happens from here, my intention is to continue support to Canada's defence and security mission, as well as to continue support and advocacy for the people who choose to make this mission their own, now, and in the future.

The officer selected to relieve me is well known to the community already, and I'd like to extend a warm and heartfelt welcome to **Commodore Michel Thibault** as the new DGMEPM. He has served the past three years as Project Manager for the River-class Destroyer (RCD) project, seeing it through to the start of the Implementation phase and construction start for the lead ship, HMCS *Fraser* (DDH). Michel's arrival in as DGMEPM is timely, as the Division needs to take a closer look at its overall structure and readiness to accept the River-class into service as part of the MEPM30 initiative. Given his experience with the RCD over the past three years, Michel is well-placed to ensure that this initiative is started on the right path.

As I depart, I would like to pass along three key messages to the community as a whole. First, that we are entering a new and potentially challenging phase of world history; one that will demand that we change our way of thinking. We are on the threshold of a generational change, and we face decades ahead that will pose greater strategic risk, including the potential for peer conflict or even global war. Concurrently, new technologies are reducing the barriers for entry into conflict by automating combat, using cheap and easy to produce remote-controlled or artificially intelligent drones and weapons to develop battlefield intelligence, and to strike targets. Many of these same technologies are additionally enabling "grey zone"

Photo by Ann Mech

conflict which may not involve direct military action but may include information warfare, cyber warfare, sabotage, targeted assassination and acts of terror carried out under the guise of plausible deniability. What this means for the Naval Technical community is that we must shift our mindset. As Canada moves with its allies to increase investments in defence and security, we need to understand the implications of moving from shortage to surplus; we need to work in partnership with the RCN, the wider Defence team, and with industry to further expand CAF and RCN capabilities; and we need to shift from a focus on safety as an end in itself, to a focus on ready, relevant and resilient forces, with safety as an enabler.

Secondly, that flexibility is a key attribute of our profession. It is often said that flexibility is the key to sea power, and although the concept is adapted from an original idea attributed to an Italian airpower theorist, it is also absolutely true. It is true in the micro and in the macro. As a micro example, two weeks ago, I encountered an unfortunate situation upon arriving in Halifax for engagements there. One of the events was planned to be in "short sleeve", but I had neglected to bring along the customary plastic nametag we wear in that order of dress. I owe a debt of thanks to **Maj (Ret'd) Denis Benoit**, RCAF, owner of DB Embroidery Solutions in Dartmouth, who personally took the time to turn out a rush nametag order for a stranger while otherwise completely slammed with work. As a result of his flexibility and assistance, I was suitably kitted out in time for my engagements. As a macro example, two weeks before my nametag faux pas, I was in Halifax for personal reasons but happened to drop by the offices of Fleet Maintenance Facility (FMF) *Cape Scott* and hear about a hull insert for HMCS *Charlottetown* (FFH-339). Just prior to my visit, a pulsed eddy current survey of *Charlottetown*'s hull revealed an area of degradation which would either have to be fixed or would result in a temporary operational restriction. With not much more than the Easter weekend to implement a repair, FMF *Cape Scott* reviewed the

results, briefed MARLANT leadership on options, and made a decision to embrace the challenge, knowing that if they failed it would delay the ship in the dock, and would also delay the docking of HMCS *Windsor* (SSK-877) by a month, since tides deep enough to dock submarines only occur with that frequency. The *Cape Scott* team succeeded despite requiring some rework during the project, and *Charlottetown* undocked on time with a brand-new hull insert. Both scenarios exemplify the good that can happen when people take the time to prioritize outcome over process, and when they flexibly adapt to the unexpected to help achieve mission success. The second scenario in particular reflects great credit on FMF *Cape Scott* and is illustrative of the value that the FMFs bring to the RCN – day in and day out.

Finally, we should feel an incredible sense of pride and accomplishment for what we do every day. What we are able to accomplish together is nothing short of amazing. From the engineering spaces and MCRs of our ships, to headquarters establishments, coast to coast and internationally, members of the Naval Technical community are keeping the RCN on mission and meaningfully contributing to Canada's defence and security. In the last three years, we were able to culminate an approximate seven-year effort to make the case for increased investment in the *Halifax*-class, leading to government approval of $10B over 20 years, resources now added to our baseline funding profile that will help keep the class operational in transition to the River-class. We've helped maintain the RCN's commitments to the REASSURANCE, NEON, NANOOK, HORIZON, and CARIBBE missions. We've fielded important new combat capabilities for the *Halifax*-class in the form of the Evolved Seasparrow Missile (ESSM) and the Underwater Warfare Suite Upgrade (UWSU). We've integrated a new and differentiated approach to *Halifax*-class Docking Work Periods in the context of the Global Steel Replacement Strategy for HMCS *Fredericton* (FFH-337) and future ships, and piloted the method in HMCS *Halifax* (FFH-330). We've returned HMCS *Corner Brook* (SSK-878) to sea after the most intensive Docking Work Period in RCN history, and we adjusted planning for the remaining *Victoria*-class submarines to maintain flexibility as planning for a replacement submarine class advances. We've accepted three new Arctic Offshore Patrol Vessels (AOPVs) into service and we are supporting the class on missions across the globe, including the first Antarctic deployment in RCN history. We are actively preparing to receive the first Joint Support Ship (JSS) into service and are currently building up the spares pool. We've experimented with novel technologies in the form of AI-enabled Uncrewed Aerial Vehicles and pre-programmed Uncrewed Surface Vehicles that will help us manage corrosion and ship signatures in the future. We've integrated pulsed eddy current hull surveys into our business, with direct benefit to our ability to sustain the *Halifax*-class in this "extra innings" phase of its life beyond the originally intended design life. New policy instruments were brought into force for cyber mission assurance and key hazard certification, and the materiel baseline standard NAVORD was updated to account for the *Harry DeWolf*-class. We are continuing the broader effort to update our Naval Materiel Management policy suite, including publication of a 2025 update to our Submarine Materiel Assurance and Certification policy, C-23-VIC-000/AG-001. Additionally, we are continuing to develop the relationship with classification society partners who will provide vital assistance to us in design certification, supply chain risk management, and in-service management of RCN ships. Experimenting with low carbon intensity fuels, we've supported policy development around greening government operations which helped generate the RCN's first-ever operational fleet decarbonization plan. Finally, several in-depth Technical Investigations have been completed to capture important lessons learned from fleet operations; two notable examples being one on *Harry DeWolf*-class Main Diesel Generator failures (2023), and another *Halifax* and *Harry DeWolf*-class Coating Failures (2025). While impressive, this list just scratches the surface. All aspects involve every part of the community, including MEPM representatives, RCN sailors, the entire government team supporting defence procurement, and Canadian and allied industry partners.

Courtesy of Cmdre Keith Coffen

Cmdre Coffen and Capt(N) McCallum, former CSEO and Assistant CSEO revisiting HMCS *Windsor* (SSK-877).

I am proud to belong to this community and I am confident in our ability to effectively manage a new set of challenges in the years ahead. I'd like to thank the past and current CRCN, **VAdm (Ret'd) Craig Baines** and **VAdm Angus Topshee**, as well as the past and current ADM (MAT), **Troy Crosby** and **Nancy Tremblay**, for the opportunity to serve as DGMEPM. I wish Cmdre Thibault every success as he leads the Division, the Branch and the wider Naval Technical community into the future. Finally and most importantly, I want to thank all of you for giving me a professional home for over 30 years and to wish you every success in your future endeavours.

Commodore Michel Thibault, CD — Incoming Director General Maritime Equipment Program Management

Cmdre Thibault joined the Canadian Armed Forces in 1992 and graduated as a Naval Combat Systems Engineer from the Royal Military College of Canada in 1997. After one year of basic trade training ashore in CFB Halifax, he gained sea experience onboard HMCS *Nipigon* (DDH-266), *Winnipeg* (FFH-338) and *Vancouver* (FFH-331).

Promoted to Lieutenant(Navy) in 2000, he saw further sea service onboard HMCS *Vancouver*, obtaining his Engineering Head of Department qualification in 2001. During that summer, he was posted to the Directorate of Maritime Equipment and Program Management (DGMEPM) as the technical manager of the In-Service Support Contract for the MCDVs, which he fulfilled until 2004. Upon return to the Pacific Fleet, he was appointed Combat Systems Engineering Officer of HMCS *Vancouver*.

On completion of his sea tour in 2006, he was promoted to Lieutenant-Commander and posted to NDHQ for a one-year assignment at the National Defence Command Center as a Senior Watch Officer, followed by staff duties within the Vice-Chief of the Defence Staff and the Chief of the Defence Staff offices. In December 2009, he was posted to the Australian Defence College where he completed his Junior Command and Staff College course as well as a Master of Arts in Policy and Strategy from the University of New South Wales. Upon return to Canada in December 2010, he was posted back to DGMEPM as Combat Systems manager for the Halifax Class Modernization program, followed by a short employment as the Above Water Warfare Equipment Group Program Manager.

Promoted to Commander in March 2013, he was posted to Naval Reserve Headquarters in his hometown, Québec city, as Chief-of-Staff and N4/N6. Concurrent with his appointment at NAVRES HQ, he assumed Command of HMCS *D'Iberville* from 2013-2014. In 2015, he was posted to MARLANT as the Deputy Chief of Staff Fleet Technical Authority and Engineering Manager at FMF Cape Scott until 2017. He then returned to the National Capital Region and assumed the responsibilities of Deputy Class Program Manager for Non-Combatants in DGMEPM. He was then assigned in 2018 to the Director General Major Project Delivery (Sea) to work on the National Shipbuilding Strategy where he was promoted to Captain(N).

Photo courtesy DND

Upon completion of his assignment to DGMPD(Sea), Cmdre Thibault assumed the responsibilities of Deputy Project Manager (Transition) for the Canadian Surface Combatant project until 2019 before being transferred to Chief of Staff Materiel as the Director Materiel Group Strategic Plans until his appointment as Commanding Officer of FMF Cape Scott in April 2020. Following two years in Command of Cape Scott, Cmdre Thibault was promoted to his current rank and appointed Project Manager for the River-class Destroyer in the NCR.

Cmdre Thibault is married to his lovely and supportive wife, and they have three wonderful children.

IN MEMORIAM

Commodore Edmund George Alfred Bowkett, OMM, CD (1934–2025)

Canada's Naval Technical community was saddened to learn of the passing of Cmdre (Ret'd) Edmund Bowkett in Ottawa on March 4th, at the age of 90. The Winnipeg native joined the Naval Reserve as a naval cadet through the University Naval Training Division (UNTD), at HMCS *Chippawa* in 1951, and in 1958 he transferred to the Royal Canadian Navy in the rank of Midshipman where he began his training as a Maritime Engineering Officer. He served 32 years as an engineering officer before retiring in 1990 as the Project Manager of the Canadian Submarine Acquisition Program.

Cmdre Bowkett had a very distinguished career. During 1964-66 he was the Engineering Officer aboard HMCS *Buckingham* (FFE-314), and both the Deck Officer and Executive Officer of HMCS *Crescent* (DDE-226). He then had the honour of serving as the first Engineering Officer of HMCS *Bras d'Or* (FHE-400), the Navy's experimental hydrofoil where he was later appointed to Lieutenant-Commander. As Engineering Officer he also had the pleasure and excitement of being onboard when *Bras d'Or* went foilborne for the first time, which was then considered the fastest unarmed warship in the world. He served in MARCOM HQ as Deputy Chief of Staff Engineering and Maintenance Section Division Head in 1972 and then off to CFB Toronto for Canadian Forces Staff College as Deputy Director Curriculum. Promoted to Captain(N) in 1982, he then held key naval engineering roles including Commanding Officer of Naval Engineering Unit Atlantic, Director Marine and Electrical Engineering including editor of the *Maritime Engineering Journal* (see *MEJs* 07-14), and Project Manager of the Nuclear Submarine Options Study.

Photos courtesy DND

His efforts did not go unnoticed as he was appointed an Officer of the Order of Military Merit and in 1988, became Director General Submarine Engineering and Maintenance.

While he was a dedicated and high achieving naval officer, his greatest love, pride and joy was his family and the love of his life, Bonnie. A wonderful father and true gentleman, he was always kind, gracious, gentle and patient, and always enjoyed a good intellectual debate. He made us all laugh with his sharp dry wit, and he enjoyed using the King's English to its fullest potential. Cmdre Bowkett enjoyed his retirement in Blackburn Hamlet and later in Russell, Ontario where he spent time with his family, refurbished his 1962 Chevrolet Impala Super Sport (SS) Convertible, and, with his son, thoroughly enjoyed volunteering with both the Bytown Railway Society and Vintage Iron and Traditions of Eastern Ontario.

He is survived by his loving and cherished wife Bonnie, his children, Edmund (Daniela), Gail (David), Kathleen (Jason) and grandchildren Sonja, Christine, Fraser and Oliver. He will be greatly missed by all who knew and loved him.

FORUM

The 'Fifth Cadet' A Personal Journey of Service to Canada

By LCdr (Ret'd) Brian McCullough, CD

"Welcome to the Chamber of Horrors, Lieutenant McCullough!"

Hardly the words of welcome I was expecting as I was ushered into the Fleet School commandant's conference room in Halifax for my 1977 Regular Force Bridge Watchkeeping (BWK) board.

The growl and mischievous scowl of the imposing **Capt(N) Richard Hitesman** could sear the epaulettes off most junior officers' shoulders, but I wasn't much in the mood for his amusements. I had a busy out routine day ahead of me, and my BWK board was just item number one on my list of things to do before catching the service flight west to join HMCS *Terra Nova* (DDE-259) the next day.

"Morning, Sir," I replied. A nod to his three commanders facing me across the table, and it was game on.

By then I was already a qualified bridge watchkeeper-navigator in the Naval Reserve, and had several destroyer/tanker deployments as a Second Officer of the Watch trainee under my belt. My demeanour may not have reflected the significance of the moment, but this board was a big step in taking things to the next level with a Reg Force BWK.

It was also a huge departure from what I imagined I'd be doing at this stage of my life. Before I was 18, the idea of joining the Naval Reserve wasn't even on my radar. Ever since I was a shy six-year-old learning how to 'get along with others' in kindergarten at RCAF Station Rockcliffe in Ottawa, there was no question that I was going to be a doctor. I have no idea how that notion found root, but the thought that I might one day be helping people as a surgeon stayed with me all through high school.

In the summer of 1970, the world as I knew it took a bit of a left turn. As my father's three-year Air Force posting to the United States came to an end, and our family moved back to Montreal, the great city where I was born, an unfamiliar surge of patriotism began washing over me. By the following summer I was so antsy that I didn't know what to do with myself. When my mother couldn't stand me bouncing off the bulkheads any longer, she steered me toward HMCS *Donnacona*, Montreal's Naval Reserve Unit.

2024 photo by Emily McCullough

It would take more than five months to finally be taken on strength as the unit's 'fifth cadet,' where I was sworn in on January 11, 1972. My seniority would be several months astern that of my classmates, but being kitted out in Navy blues with a Canada flash on the shoulder meant the world to me.

In December 1973, now a sub-lieutenant, my life took another hard a-port. On the spur of the moment, I abandoned a frustrating first-year university program in Montreal to join HMCS *Qu'Appelle* (DDE-264) on its transfer from Halifax to the West Coast. As I stood on the fo'c'sle with the other special sea dutymen in the freezing cold on January 7th, it hit home that this was going to be vastly different than my previous Naval Reserve gate vessel summer training cruises in BC's Gulf Islands. Ahead of us lay such exotic-sounding places as Kingston, Jamaica, the Panama Canal, Mazatlán, Mexico, and San Diego, California, and I wondered how I could be so lucky — that is, until the winter North Atlantic started messing with my internal gyro.

Running away to sea as a 20-year-old might not have seemed like the smartest thing to do from my parents' perspective, but I was all in. Not enough to join the Regular Force, mind you — there was too much of the rebel Reservist in me to do that — but over the next six years I lived a mixed bag of Regular Force and Naval Reserve time at sea, and Reserve unit division time ashore.

I was keen on learning as much as I could of the navigational arts, becoming a dependable bridge watchkeeper, and doing my best to support the people in my division. In those days my sextant and star globe were never far from hand, and I rarely missed an opportunity to grab a sun line or star altitude. I especially cherished the quiet times on the flag deck, often with the CO, as we shot evening stars.

During fishery patrols on the Grand Banks aboard HMCS *Nipigon* (DDH 266), I pioneered a 'muscle memory' sextant method for obtaining an accurate daytime position line when the sun was visible above a horizon that was obscured by low-lying fog. The other watchkeepers thought I was crazy until I showed them that I could produce a reliably consistent cocked hat error of six-nautical miles or less.

I was motivated. This was the practical kind of education I was looking for, and in later years I'd look back at this time as my 'University of the Sea,' culminating in the completion of my Naval Reserve and Regular Force BWK qualifications before I even had a licence to drive a car. (Hopping from ship to ship in those years, my learner's permits kept expiring before I could take a road test.)

The strangest pier-head jump I ever made happened in mid-December 1977 while I was in Halifax as advance party for an upcoming Naval Reserve gate vessel weekend. Before flying back home to Ottawa, I went up to the Stadacona Wardroom for lunch, and found myself in line behind a couple of senior officers who were engaged in a lively conversation. It quickly became apparent that they were the CO and XO of one of the AORs, and were short a bridge watchkeeper for their upcoming CARIBOPS deployment.

As I listened, the exasperated captain turned to his XO and snapped, "Where are we going to find another BWK at this late date!"

I cleared my throat. "Excuse me, Sir. I couldn't help overhearing. I have a Reg Force BWK, and I'm available."

Which is how I became Deputy Deck Officer in HMCS *Preserver* (AOR 510). The ship was familiar to me, as I had served aboard it under a different captain the year before on a deployment to Northern Europe. I guess it's true that you make your own luck.

BWKs of any kind were in high demand throughout the Naval Reserve, and transferring skills from the Regular Force to the Reserves proved quite successful. Based on my experience in the destroyers, I worked with former *Terra*

(Continues next page...)

CAF photo

Ambushed in 2017 by RCN Commander VAdm Ron Lloyd and Command Chief Petty Officer CPO1 Michel Vigneault with a second CRCN Commendation for my work on the *Maritime Engineering Journal*.

It was nine o'clock in the morning, and I already had two beers under my belt to calm my nerves after the captain ordered me to pipe us in to Seattle's Lake Union in 1975.

Photo by Lt(N) Chris Hircock

While covering the annual Naval Technical Seminars for the *MEJ*, I never missed an opportunity to go aboard ship to speak with people, and to stay connected with the environment that has sustained me for more than half a century.

Photo by Bill Gard

At work in Halifax in 2018, with Canadian Naval Memorial Trust Chair Wendall Brown.

Reporting from the field: As class senior for the 1988 CAF Base Editors Course in Edmonton, it was a real privilege to interview soldiers on exercise at CFB Wainwright for our class newspaper project.

Nova Commanding Officer **Capt(N) Max Reid** at HMCS *Carleton* in Ottawa to train Reserve personnel in ops-bridge radar reporting procedures that we later used at sea in the gate vessels. We and others worked hard in those days to improve the level of professionalism in the Naval Reserve.

I learned from some wonderful teachers, including one training officer who gave me a well-deserved kick in the rear the summer after my *Qu'Appelle* trip (thank you, Hugh M!). But it is my mentors aboard HMCS *Terra Nova* in 1975 who I think of most often.

In 1979, when I was 26, I washed up on the shores of the Maritime Engineering and Maintenance Division in Ottawa. I was hoping to punch a year or two of Class C service to tide me over a rough spell, but two years somehow stretched into 16, and the rest is history. DGMEM kindly welcomed me into their fold, and here I am, still with a bit of a hand in on the *Maritime Engineering Journal* 46 years later. It makes me proud to know that this amazing technical forum, the brainchild of **Cmdre (Ret'd) Dennis Reilley**, (see *MEJ 100*), is by far the longest-serving branch periodical still in continuous publication in the Canadian Armed Forces.

I paid a price for following a non-conventional path during my 25-year stint with the Navy. And yet, while I was unable to contribute to a pension myself, I launched a successful grassroots campaign in the mid-1980s to bring about sweeping changes to improve the conditions of pay and employment for Reservists on long-term call-out with the Canadian Armed Forces. I do regret that I never completed a university degree, but charting my own course to qualify as a navigator worked best for me at the time, so maybe a civilian parchment was never really in the cards for *Donnacona*'s 'fifth cadet.'

One thing I am supremely thankful for is that my editing skills, such as they are, have been of some assistance in helping people publish their wonderful articles through the pages of the *MEJ*. I can't thank the Canadian Naval Technical community enough for giving me such an extraordinary opportunity to serve in this way.

Now, at the age of 72, the time has come for me to dial back on my work hours so that I can focus on personal writing projects and take care of things that need attention on the home front. What makes it easier is knowing that the watch is safely in the hands of production editor **Ann Mech**, and production coordinator **Jacqueline Benoit**.

Not long after I joined the Naval Reserve, I read a quote from **Admiral Lord Nelson** that read: "Duty is the great business of a sea officer: all private considerations must give way to it however painful it is."

The words resonated deeply with me then, and still do to this day. Whether we are military or civilian, service to Canada is a journey we travel together. It's about honoring those who served before us, supporting those who serve now, and having respect for the ones who will take our place. What I appreciate most about my own service is the common purpose that brings us together for the betterment of Canada, and it is this that continues to shape my life more than anything else.

LCdr (Ret'd) Brian McCullough was the production editor of the Maritime Engineering Journal. Since its inception in 1982, he guided this award-winning technical forum through 111 editions.

FEATURE ARTICLE

Maximizing Vulnerability Protection During Ship Design – The River-class Destroyer Approach

By LCdr Eric Poulin

As one quickly observes when they join the navy, the main difference between naval and civilian vessels is the naval ability to fire weapons. Conversely, this means that naval vessels must also have the ability to survive enemy fire to carry out its mission. This is not a new concept, as warships throughout history have been armoured to protect against enemy gunfire. HMS *Victory's* hull was built of two-foot-thick oak timbers at the waterline to protect against cannon fire. However, with advent of modern weaponry, the ability to survive the effects of weapons has become much more challenging.

There is a misconception that today's warships can be considered "one-shot" ships, in that if attacked by a modern weapon, the ship has very little ability to survive post contact. This is exacerbated by news headlines coming out of the war in Ukraine. Ukrainian forces, using only small anti-ship missiles and swarming drone attacks, have successfully repelled the Russian Black Sea Fleet, including sinking Russia's flagship cruiser *Moskva* (121), and the corvette *Ivanovets* (954).

While these sinkings do happen, there are many other examples of ships that were damaged by enemy weapons and yet were able to continue their mission. These include the Iraqi missile attack on USS *Stark* (FFG-31) and the Iranian mine detonation on USS *Samuel B. Roberts* (FFG-58). Both ships were able to return to port post incident, conduct repairs, and return to duty.

Many vessels today can survive modern weaponry due to the adherence to the principles of survivability. Survivability can be broken down into three pillars:

1. **Susceptibility:** The ability to reduce the probability of being hit by an enemy weapon through signature management, decoys, and electronic warfare;
2. **Vulnerability:** The ability to reduce the probability of being disabled after being hit by an enemy weapon; and
3. **Recoverability:** The ability to repair and rectify damage after the ship has been attacked by an enemy weapon using damage control and firefighting techniques.

www.navalofficer.com.au

Russian Cruiser *Moskva* post attack from Ukrainian Neptune Anti-ship Missiles

Wikimedia Commons

USS *Stark*, photographed post missile attack in the Persian Gulf

Susceptibility and recoverability concepts are well known within the Naval Technical Officers community, so this article will concentrate on vulnerability, and how vulnerability reduction characteristics are built into a warship during the design process.

Before discussing vulnerability reduction characteristics, it is important to characterize the current threat weapon space. Current weapons can be divided into three categories: above water threats, below water threats, and asymmetric threats. Above and below water threats are fairly straight-forward: as they consist of anti-ship missiles, torpedoes and mines munitions that have been fully characterized since the use of

(Continues next page...)

Exocet Missiles on UK warships during the Falkland war. The last threat category is still emergent and many allied navies are working to categorize the different possible munitions. Asymmetric threats have developed in response to traditional blue water navies, including the Royal Canadian Navy (RCN), moving their operations into littoral waters. This has led to new weapon types that have never been used against modern warships. This includes small arms fire, rocket-propelled grenades (RPGs), and the use of improvised explosive devices (IEDs) at the hull line – as seen during the USS *Cole* (DDG-67) attack while in harbour, and the *Ivanovets* attack by Ukrainian uncrewed drones.

Thus, due to the number and varied types of threats previously described, considerable effort should be put into the design of the ship and onboard systems at the earliest stages of design to reduce ship vulnerability. The UK Ministry of Defence, in "Materiel Acquisition Publication 01-105 The Vulnerability Reduction Compendium"[1] highlights six steps in early-stage design to maximize vulnerability reduction. As the River-class Destroyer (RCD) is using the UK Type 26 parent design, these steps have also been utilized by the RCD design team during the design and integration process:

Step 1: Prevention of catastrophic loss. This step is characterized by the ship having sufficient residual strength and stability to remain afloat following a major warfare incident. Furthermore, magazine protection must be prioritized to ensure onboard weapons do not react in an explosive manner due to enemy action.

Step 2: Reduction in the number of critical elements. In other words, ensure as much of the key capabilities of your ship's primary mission have redundant equipment. On many Canadian naval ships, this has led to multiple generators and switchboards, as well as primary and secondary control locations for key weapons and sensors.

Step 3: Concentration of critical elements. If it is not possible to have redundant equipment for your key systems, then it is advisable to move all these critical items as close together as possible, thereby making it a smaller target for enemy fire. For example, if a ship has only one Sonar Instrument Space for one Hull Mounted Sonar, it makes sense to co-locate the space and the sonar to minimize the sonar's footprint throughout the ship.

Step 4: Separation of redundant items. The principle of redundancy only works if the redundant equipment is sufficiently separated from one another. If they are too close, then one enemy weapon could take out all the redundant equipment, thereby taking out key systems.

Step 5: Protect remaining vulnerabilities. Ensuring best practices in ship design for vulnerability are followed. This includes utilizing properly shock tested equipment and mounting key equipment on shock mounts or rafts to protect against underwater explosions, using blast resistant structures at key points in the ship, and using ballistic armour to protect against small arms fire.

Step 6: Hit Point Management. Modern weapons have the ability to target specific points on the ship, especially small arms in close combat littoral situations. Therefore, it is beneficial to attempt, when possible, to place critical systems away from obvious points of aim, including the bridge and mast.

At the system level, it may seem easy to follow these steps. However, when all systems are put together in a whole ship model, along with the ship's structure and hotel services, it can become very difficult to determine whether the ship has enough resistance to enemy threats. To solve this problem, many nations have developed vulnerability assessment tools. For the RCD, the design team has contracted support to use the Purple Fire Vulnerability Assessment tool, developed by Survivability Consulting Limited (SCL).

At the simplest level, vulnerability modelling is attempting to discover how vulnerable a ship design is, why it is vulnerable, and how can this vulnerability be decreased. These questions can be answered using three criteria for post hit functional performance:

1. The Probability of Escaping Critical Damage (PECD), or the probability that a specific warfighting function will still be available after it has been damaged;
2. Maximum time to recover, or the max allowable time after damage for which the warfighting function can be recovered. If it takes longer than this max time, then it is treated as having failed; and
3. Minimum duration, or the requirement that each warfighting function affected by damage is required to remain available for at least 15 days following weapon impact and recovery, or the maximum endurance of the vessel if it is less than 15 days.

1. *The Surface Ship Vulnerability Reduction Compendium*, Material Acquisition Publication 10-105, Naval Authority Group, Issue 3, August 2021.

Before any analysis is conducted, a model of the ship in question needs to be built. Though not as complex as the full computer-aided design (CAD) model of a ship, a model in Purple Fire can become incredibly intricate, as seen below, with details of the ship structure and all equipment onboard.

During the requirements reconciliation process for the RCD project, a series of ship functions were developed, which broadly relate to the mission set derived for the vessel. This can be very basic, such as minimum propulsion, to much more complex such as anti-submarine warfare. To ensure that all the equipment required to meet the ships functions are accounted for, a series of fault trees were created within Purple Fire, as seen in the adjacent simplified figure. Equipment (colour coded green) are arranged into sub-systems (yellow for expanded subsystems below, blue for unexpanded). All together they represent all the requirements to meet the ship function (red).

To assess a given vessel against these requirements Purple Fire uses three models: one of the ship/target, one of the weapon, generally falling into one of the classes described earlier, and third, a scenario. The scenario can include a single missile hit in a specific spot on the ship, or it can be an entire grid of weapon hits to conduct a probabilistic analysis. Once these models are inputted into the Purple Fire tool, it analyses the weapon in the specific scenarios to how it interacts with the ship. The primary and secondary damage is determined, along with reactions to specific damage by the equipment and/or the crew. If a space is considered damaged, then it is assumed the equipment in the space is

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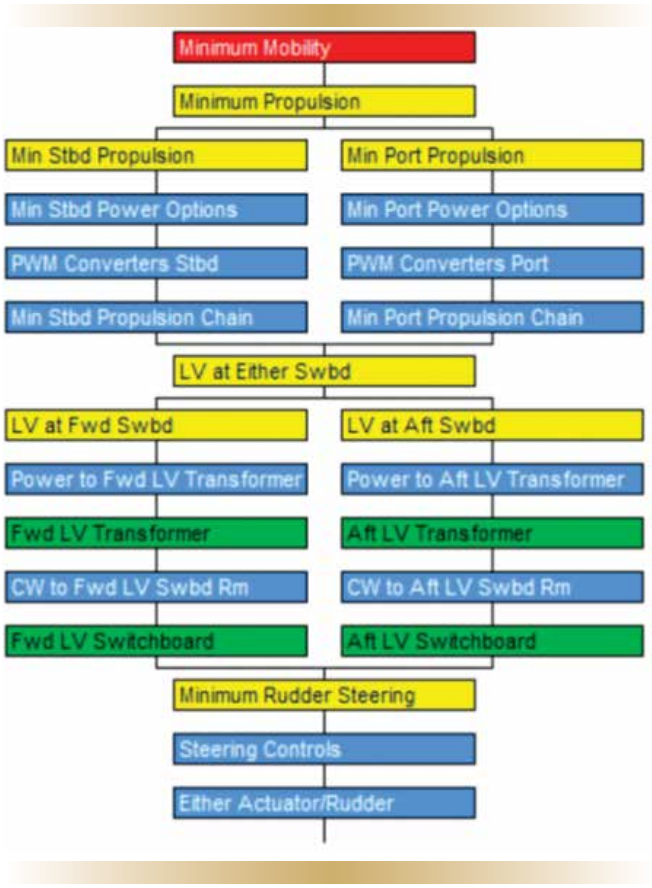
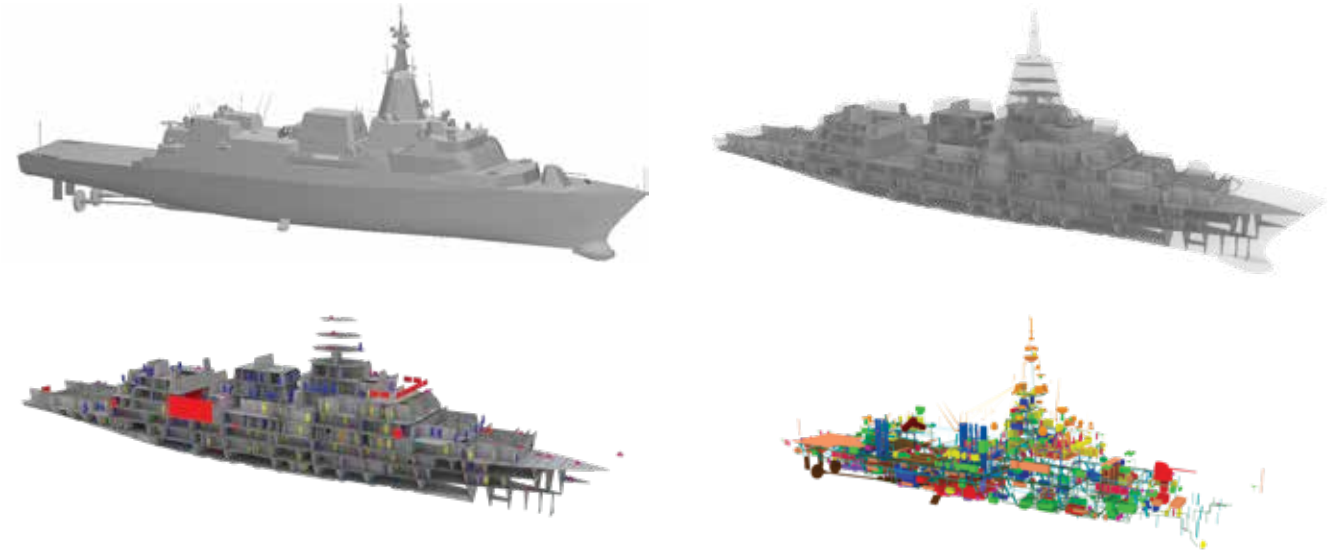


An example fault tree for a ship's minimum mobility requirement.

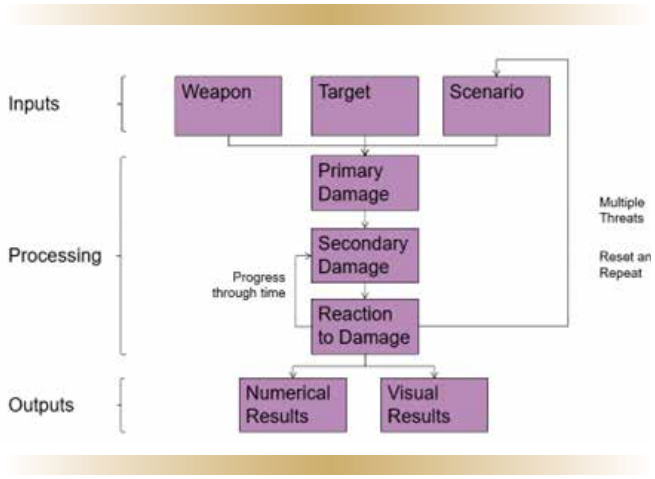


Example layers of Purple Fire ship models that were developed specifically for this article by Survivability Consulting Limited the OEM for Purple Fire Software.

damaged as well. The program will review the fault trees and then determine whether a function or a mission is affected. Finally, the tool will output numerical and visual PECD results showing the ship's ability to withstand the selected weapon.

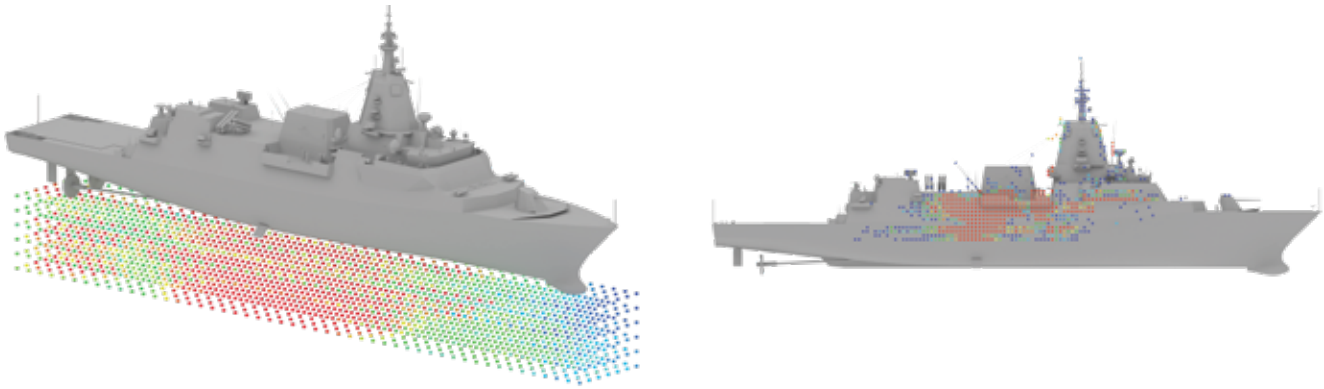
The use of the Purple Fire Tool opens many different opportunities to optimize the RCD design. The most obvious uses provide the designer with the information to influence the ship design at all stages to ensure proper survivability and for providing the RCN with comprehensive survivability knowledge of the completed vessel. This can assist in the planning of missions based on known threats and provide ship commanders the knowledge necessary to assist in fighting the enemy in a way that will maximise ship survivability. Purple Fire, and other vulnerability assessment codes, are also extensively used both during build and in-service for the analysis of Engineering Changes (EC). As the PECD values are requirements which must be met and maintained while in-service, the survivability impact of all ECs must be evaluated. If deemed deficient, Purple Fire can also assist in developing adjustments to ECs to ensure their compliance to PECD requirements.

Warzones have become more and more hostile to warships. From Ukrainian missile attacks in the Black Sea, to Houthi Drone attacks in the Red Sea, warships are being targeted more often than in recent memory. This has made the ability of a warship to withstand damage a significant advantage in enemy waters. The work to meet this goal starts at the earliest stages of ship design and must be a whole team effort to be successful.



Purple Fire Analysis Flowchart

LCdr Eric Poulin is the Transversal Requirements Lead for the River-class Destroyer (RCD) Project



Visual Results of an Underwater threat grid (left), and an Anti-Ship Missile threat grid (right), with the colours reflecting the modeled PECD levels for an attack at a particular point, decreasing from high PECD (blue), to low (red). Provided as examples only for this article by Survivability Consulting Ltd.

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.

FEATURE ARTICLE

Evolution of the Recognized Maritime Picture Systems within the Royal Canadian Navy

By Ken Berry, CD

The Recognized Maritime Picture (RMP) is a visual aid representing the operational information from a variety of sources, and it includes all aspects of the maritime operating environment.

On a ship the RMP is used to visualize the vessel traffic based on the ashore and other maritime data sources. In the ashore operations centres, the RMP is drawn together using a multitude of maritime data sources, other operations centres, and authoritative vessel databases. Once assembled, the RMP represents the maritime component of the Canadian area of responsibility (AOR) and the remainder of the maritime realm.

In the last four decades, the RCN has made great progress with the handling of the RMP both onboard ship and ashore. In the beginning, the General Operation Plot (GOP) manually plotted LINK 11, LINK 14, Over the Horizon (OTH) Gold messages, intelligence reports and sightings with a pencil on paper to produce the shipboard RMP plot (see *MEJ* 111). Ashore at headquarters, vessel position reports and the same message data were also manually maintained on a large plot.

Modernization in the RCN began when the GOP was replaced on the command platform *Iroquois*-class ships in the late 1980's to early 1990's with the Joint Operational Tactical System (JOTS) as a mission fit for HMCS *Athabaskan* (DDG-282) during the Gulf War. JOTS was limited as it was operating at teletype speed on the high frequency radio teletype (HF RATT) circuitry and limited the number of tracks able to be displayed. Late in the ninety's, the Joint Maritime Command Information System (JMCIS) replaced JOTS, while initially operating at teletype speed on the HF RATT circuitry, the maximum number of tracks increased but it was still a small number. JMCIS was the initial trial run for satellite communications of the RMP to and from ashore.

Between 1997 and 1999, JMCIS evolved into the Global Command and Control System – Maritime (GCCS-M). It operated initially on the HP 9000 PC, then the TAC-3 (HP 755) computer, and later the TAC-4 (HP J210) computer systems. It began simply operating at teletype speed on the HF RATT circuitry, but based upon the

RCN photo

GCCS-M V 3.0.X
TAC-3/4 CONSOLE

JMCIS network evaluation, GCCS-M leaped into the future with the introduction of LAN/WAN operations with a shore-based operations centre. The TAC-3 and TAC-4 computer and consoles were interfaced to LINK 11 as a secondary source of RMP data. GCCS-M was fitted on the *Iroquois*, *Halifax* and *Protecteur*-class ships in various configurations of the three computer systems.

The Global Command and Control System – Maritime (GCCS-M) is a near real-time command, control, communications, computer, and intelligence (C4I) system. Built on the Common Operating Environment (COE), GCCS-M correlates and associates/merges contact information from multiple sources to provide a Common Operating Picture (COP). In addition to the tactical picture, GCCS-M

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provides a suite of tools and applications to aid the operator in making the most of the information provided. It is a critical system for the Royal Canadian Navy in managing and sharing the Recognized Maritime Picture (RMP) when operating with coalition forces. Canadian ships can exchange GCCS-M messages on a variety of international and national communications networks (i.e. CSNI) to produce a fused tactial picture.

With the introduction of the International Maritime Organizations Safety of Life at Sea there was a requirement for an Automatic Identification System (AIS) transponder onboard ship by the year 2000. Defence Research and Development Canada (DRDC) Atlantic and RJOC (A) originated the software and hardware concept to create an AIS2Gold system. AIS2Gold allows the AIS data to be converted to an understandable format for both GCCS and MCCIS by converting the AIS messages to the Over The Horizon (OTH)-Gold Format. The OTH-Gold messages were sent to GCCS-M or MCCIS over the classified network and were automatically forwarded to the Regional Joint Operations Centre (RJOC). This increased the capability of the ships ability to supply an improved real time RMP data to the RJOC. AIS2Gold was fitted on both the *Halifax* and *Iroquois*-class ships.

A Command-and-Control Personal Computer (C2PC) laptop is an extremely limited version of GCCS-M which is still utilized by the *Kingston*-class Maritime Coastal Defence Vessels (MCDVs). C2PC is an end-of life product for the Navy, and the RCN is seeking a replacement for this system on the MCDVs.

In 2011, the *Victoria*-class submarines began to be fitted with GCCS-M. Utilizing a TAC-3 variant designed for United States Navy submarines, the B2600 computer and this fit included a LINK 11 USQ-125 for a secondary data source. The B2600 is also an end-of-life product for the Navy and the RCN is seeking a replacement for this system on its submarines.

Also in 2011, a maritime evaluation was conducted onboard HMCS *Ville de Québec* (FFH-332) to replace the Version 3.X of GCCS-M with GCCS-M Version 4.X onboard the *Halifax*-class ships. Version 4.X is a Space and Naval Warfare Systems Command (SPAWAR) Solaris UNIX based system and will only run on a specific commercial off-the-shelf server as it is a closed architecture system, meaning that the software is directly tied to the hardware. Thus the servers were obsolete, or at end-of-life by the time they were installed, and an updated version required a new server and software licensing.

The *Halifax*-class ships initially received GCCS-M Version 4.01 as the replacement for the TAC-3 and TAC-4 computers, maintaining the common operating environment previously utilized. Version 4.01 was the introduction of the remote display of GCCS-M on the CSNI thin and thick clients for the COP.[1]

Version 4.02 and 4.03 of GCCS-M were the next upgrades installed on the *Halifax*-class ships that occurred between 2012 and 2018. As stated above this meant upgrading the servers along with the software. These two upgrades improved network security, stability, operability and allowed the use of multiple client incidents to be displayed by the operators but remained unable to manage substantial amounts of data from the shore-based operations centre.

In 2014, the MCDVs and the Regional Operations Centres received the Interdepartmental Maritime Integrated Command, Control and Communications System (IMIC3). This was unclassified RMP shared with the Canadian Coast Guard on the Canadian Maritime Network (CANMARNET), an unclassified network. The objective of the project was to create a deployable interagency information exchange tool to enhance maritime situational awareness, improve informed decision-making and facilitate coordinated action. Whether the task was search and rescue, coastal surveillance, asset protection, anti-piracy, or interdiction, this advanced commercial technology provided a comprehensive maritime mission management system.

In 2018, GCCS-M Version 4.03 was interfaced to the Command Management System Version 5.0 (CMS 330) to provide bi-directional exchange of track data between the two systems, further enhancing the RMP reporting capabilities of the *Halifax*-class ships.

In 2021, HMCS *Harry DeWolf* (AOPV 430) was equipped with a portable IMIC3 system. In 2022, HMCS *Margaret Brooke* (AOPV 431) received the same upgrade. Again, they are being supplied, and contributing to the unclassified RMP.

1. Thin clients are devices that are primarily designed to connect to and interact with a server, while Thick clients are applications that are primarily processed on the clients' device.

The two *Protecteur*-class Joint Service Support (JSS) ships are planned to be fitted with GCCS-M Version 4.03. The current plan is to be upgraded after acceptance dependant upon the next system.

It should be noted that from the initial deployment of JOTS to the presently deployed GCCS-M 4.X version, the shore-based Regional Joint Operations Centres (RJOC) and Base Information Systems (BIS) Vessel Monitoring Support have always supported and improved the RMP sent to the ships. Every deployment of a system or version was first evaluated and trialed by the BIS Vessel Monitoring Support in the RJOC.

The RCN is now actively seeking a replacement for the GCCS-M system on all class of ships and submarines and the RCN has options to consider before the retirement of the GCCS-M 4.0.X systems. For the near future, the Navy will have to maintain the current GCCS-M while the Director Naval Requirements (DNR) identifies the future C2 requirements. The solution could be to replace GCCS-M 4.0.X with GCCS-Joint (GCCS-J), or the pared down GCCS-M v4.1.2.1; both of these are open architecture systems meaning they are not tied directly to any specific hardware, but these systems are missing vital segments such as water space management, the missing segments have been integrated into larger systems including the United States Navy (USN).

The USN SPAWAR, now called Naval Information Warfare Systems Command (NAVWAR), has declared that GCCS-M Version 4.0.X and those associated GCCS-M systems are at the support and inter-operability end-of-life. The USN is planning to interface the GCCS-M v4.1.2.x or other variants for the COP feed to the US Maritime Tactical Command and Control 2 (MTC2) system and the Undersea Warfare Decision Support System (USW-DSS) system for ships and submarines.

With the ever-changing geo-political landscape, and continuous improvements to technology, undoubtedly the RCN will continue to develop and expand the RMP for the future fleet.

Ken Berry, is a Technologist at Combat and Control Systems Engineering, FMF Cape Scott.

FEATURE ARTICLE

Ensuring Fleet Excellence: NETE's Testing and Validation for Continued Navy Success

By Tytus Drewnowski P.Eng. PMP

The Naval Engineering Test Establishment (NETE) plays a crucial role in the Independent Verification and Validation (IV&V) of the Navy's systems, ensuring they meet the highest standards of performance, reliability, and safety. As a specialized field unit, NETE provides the Navy with the tools, systems, and data necessary to ensure equipment operates optimally under the most challenging conditions. A key component of NETE is the Electronics Measurement and Control (EMC) group, which focuses on a broad range of innovative electronic testing solutions, including instrumentation, data acquisition, measurements, and control systems. A major asset of EMC is its capability to create custom testing solutions, alongside expertise in both hardware and

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Images courtesy NETE

Figure 1. Ruggedized Data Acquisition System

software design. From shock testing and custom sensor development to the design of complex test cells, EMC provides tailored solutions to meet the needs of the Royal Canadian Navy (RCN) and other branches of the Canadian Armed Forces.

Shock Testing: Validating Naval Systems Under Extreme Conditions

Shock testing is a critical capability for validating the structural integrity and operational readiness of naval systems under extreme conditions. NETE's specialized multi-disciplinary engineering team within the EMC group is equipped with a range of cutting-edge Data Acquisition Systems (DAS), designed and integrated in house (Figure 1). We utilize high-end acquisition platforms, such as Dewesoft hardware, integrated into custom-designed shock-resistant enclosures to further enhance the shockproof capabilities of these devices, ensuring consistent and reliable data capture on-board during high-impact tests. To assess the structural integrity of systems being tested, various sensors are employed, including accelerometers, strain gauges, and dynamic shock sensors, providing comprehensive insights into how systems respond to intense shock events. NETE conducts Full Ship Shock Tests, Light, Medium, and Heavy Weight Shock Testing, and Underwater Explosion (UNDEX) tests, all designed to simulate the extreme conditions faced in real-world scenarios such as explosions, emergency situations, and high-readiness operations (Figure 2). These tests are designed to assess the resilience of both the ship's structure and the readiness of the crew under the stress of actual combat or emergency conditions. The resulting data and analysis allow for the identification of potential vulnerabilities and the implementation of design improvements; ensuring that both the systems and crews are fully prepared for any operational scenario.

Custom Electronic Design and Test Cells: Tailored Solutions for Naval Operations and Testing

As part of NETE's broader mandate to support the readiness and resilience of the RCN, EMC specializes in providing custom design solutions. These range from the creation of custom test cells to the design of custom electronic sensors or Embedded Real-Time Control systems for various testing needs. With a focus on testing, validation, and innovation, EMC designs and develops cutting-edge electronic systems and purpose-built testing solutions that ensure systems perform reliably under even the most challenging operational environments.

Figure 2. Heavy Weight Shock Test

A core capability is the ability to create test cells, such as the Submarine Escape System, the Land-Based Test Site for the Paxman submarine diesel engine (*Victoria*-class), or even supporting the Canadian Army with a test cell for the Leopard 2 Engines, or, in the past, gas turbines testing (Figure 3). These test cells are engineered to replicate the conditions systems will face during actual operations, providing crucial data for assessing their performance, resilience, and operational efficiency. Whether simulating environmental stress, shock resistance, or overall functionality, these cells ensure that naval equipment is fully validated before deployment.

In addition to test cells, the EMC group specializes in software design and electronic hardware integration to create fully customized data acquisition systems, sensor arrays, and control units tailored to address the specific requirements of naval operations. For example, the team developed a custom level sensor for submarine escape system simulations, capable of withstanding extreme underwater pressures. While such design projects may represent smaller-scale solutions, they demonstrate the engineering team's ability to deliver innovative, high-performance systems tailored to meet specialized needs. EMC's custom data acquisition systems have been instrumental in supporting a whole range of tests. One of the highlights was the design of a custom monitoring device (MiniDAS) to measure shock exposure on high-speed operations of Rigid Hull Inflatable Boats (RHIBs), along with all ship dynamics including position, speed and attitude in a hand-sized compact and field-proven design (Figure 4). These boats can experience intense shock waves when traveling at high speeds over rough waters, and the data collected helps determine how well the boats and their equipment can withstand these forces. By accurately capturing these measurements, EMC contributes directly to the improvement of the boats'

design and durability, as well as military personnel safety. Among many other custom systems, EMC also developed custom communication systems for Canadian Special Operations Forces Command and instrumented diving chambers for the Canadian Navy's Experimental Diving & Undersea Group (EDUG). This cooperation across the Navy helps the different units to enhance operational readiness or allows various research projects to become a tangible reality.

High-Speed Video Recording for Detailed Analysis

Another unique capability that NETE offers through EMC is high-speed video recording. This technology is crucial for capturing fast, dynamic events like shock testing and missile firings. High-speed cameras allow us to record these high-velocity events in slow motion, providing detailed insights into the performance of various systems.

For shock testing, high-speed video enables engineers to observe how systems react during the shock event, identifying weak points or areas where design improvements are necessary. Similarly, for missile firings, the video captures the trajectory, launch mechanics, and impact dynamics, providing vital data that can be used to refine missile systems and ensure their accuracy and reliability (Figure 5). The ability to document these events in high detail enhances the overall testing and validation process, providing both visual evidence and critical data to support system improvements. Photogrammetry software tools are also used to create 3D models from recordings and provide trajectory data.

Conclusion: Ensuring Fleet Excellence

In conclusion, NETE and its Electronics Measurement and Control (EMC) group are vital to ensuring the operational readiness and resilience of the Canadian Navy. Through advanced shock testing, custom electronic design, and innovative software and hardware solutions, EMC delivers critical insights and reliable systems that support the Navy's demanding operational needs. By integrating cutting-edge testing capabilities and providing tailored, high-performance solutions, EMC enhances the performance, safety, and longevity of naval assets, ensuring the Navy's preparedness for any future challenges.

Tytus Drewnowski is the Group Leader for the Electronics, Measurements and Control, Combat and Control Systems at the Naval Engineering Test Establishment (NETE).

Figure 3. LBTS Paxman Diesel Engine

Figure 4. Custom Data Acquisition System MiniDAS

Figure 5. High Speed Video: Light Weight Torpedo Firing

Awards

Congratulations to our Award winners!

Lockheed Martin Canada Award

Photo by Ann Mech

Lt(N) Lucas Normand (in absentia)
Top Naval Combat Systems Engineering Officer
Basic Qualification Board
Accepted on his behalf by Lt(N) Joey Lord

Presented by Simon Hughes
Senior Business Development Manager
Lockheed Martin Canada Inc.

MacDonald Detwiler & Associates Award

Photo by Ann Mech

Lt(N) Courtney Williams
Top NTO candidate to achieve
Head of Department qualification

Presented by Douglas Renken LCdr (Ret'd)
Project Manager
MDA

Photo by Gabrielle Brunette

Cdr Helga Budden
Cmdre(s) Keith Coffen and Michel Thibault recognized Cdr Helga Budden with a shadow box containing a DGMEPM coin for her participation in the Naval Engineering Council (NEC). Cdr Budden served as one of the representatives for female engineers during a period when there was no female Capt(N) in the Naval Engineer occupation.

Photo by Gabrielle Brunette

FMF Cape Scott played a crucial role in the introduction of the Under Water Suite Upgrade (UWSU) capability on HMCS *Ville de Québec* (FFH-332). Recognized are: Jason Scott and Phil Pidgeon (absent) from Engineering, and the many skilled Production Technicians from Sonar Mechanical, CANTASS and Sonar Electronic Shops represented by Daylen White, Jacob Nicholls, and Ryan Bell.

Awards

Photo by Gabrielle Brunette

Lt(N) Matt Smith

Recognized for his outstanding support in resolving conflicting trial requirements, Lt(N) Matt Smith requested deviations for material shortages and tactfully liaised with ship's Heads of Departments and FER staff and ensured ship programs remained on track. Lt(N) Smith's charismatic personality has allowed him to establish an excellent rapport with various internal and external stakeholders.

News Briefs

Photo by Brian McCullough

VAdm Murray NTO-NWO Challenge Cup

The RCN's Naval Technical and Naval Warfare communities went head-to-head in the 6th annual Vice-Admiral Murray Challenge Cup game at the Bell Sensplex in Kanata. **Cmdre Keith Coffen** and **Cmdre Jason Armstrong** faced off for the ceremonial puck drop by **Admiral Ali**, Chief of the Indonesian Navy, as **RAdm Steven Waddell**, and Honorary Royal Canadian Legion Grand President **VAdm (Ret'd) Larry Murray** monitored the proceedings.

FMF Cape Scott Conducts Significant Syncrolift Deck Timber Replacement Ahead of Critical Navy Dockings

By Gabrielle Brunette

Fleet Maintenance Facility (FMF) Cape Scott has been conducting maintenance on the Syncrolift to ensure that it is operational for upcoming dockings.

The replacement of the deck timbers is critical to ensure the availability of the Syncrolift for essential maintenance work. This includes preparing HMCS *Ville de Québec* (FFH-332) for its scheduled maintenance at the end of January, as well as enabling an extensive underwater inspection for HMCS *Charlottetown* (FFH-339) ahead of its third-line docking work period.

Simon Dubois, Engineering Manager at FMF Cape Scott, said the docking facilities are used extensively in *Halifax*-class ships and *Victoria*-class submarine maintenance – averaging two *Halifax*-class dockings every year, and a multi-month *Victoria*-class docking every two to three years.

"Over the last few years," Dubois explained, "both FMF docking facilities have seen increased use for unscheduled second-line maintenance, or to support Director Maritime Equipment Program Management Major Surface Combatant pre-docking work period surveys on the *Halifax*-class ships."

Dubois went on to say that the duration of *Halifax*-class third-line DWPs continues to increase due to the age of the ships, thus occupying industry graving docks for longer periods of time.

Having a functioning Syncrolift is crucial for supporting the Royal Canadian Navy's fleet, ensuring that FMF Cape Scott has the capability to assist with both planned and unscheduled maintenance periods.

News Briefs

Recognizing our Marine Technicians

(Courtesy Our Navy Today)

The RCN is taking steps to acknowledge the dedication and hard work of our Marine Technicians (MAR TECHs).

Since the trade stood up in 2017, MAR TECHs have faced increased demands, often serving on multiple ships back-to-back to support operations and training.

The RCN is focused on setting the proper foundation to evolve the occupation for the better by shifting back to a maintainer/operator model, creating two new roles: Marine Systems Mechanical Technician and Marine Systems Electrical Technician, with implementation set for late 2025.

To recognize their hard work and resilience through these difficulties while keeping the fleet ready, a one-time allocation of 20 days of Chief of the Defence Staff special leave has been approved for qualifying MAR TECHs. See NAVGEN 14/25.

Marine Systems Technicians Graduate From New Training

(Courtesy Our Navy Today)

The RCN has reached a major milestone with the graduation of the first Marine Systems Technician (MST) course at Naval Fleet School Pacific. This marks the beginning of a new, specialized training model that replaces the broad Marine Technician trade with two focused roles: Marine Systems Mechanical Technician and Marine Systems Electrical Technician.

The change reflects a return to specialization, allowing sailors to build deeper expertise in their chosen field. It also streamlines training by reducing redundancy and increasing hands-on learning.

Senior naval leaders attended the ceremony, celebrating the shift as a move toward stronger operational readiness and technical excellence. The new training system also aims to attract recruits with clear career paths in either mechanical or electrical systems.

Graduates of the first Marine Systems Technicians course at Naval Fleet School Pacific.

News Briefs

LCdr (Ret'd) Stephen H. Darrigan's Quilt of Valour Ceremony

By Capt(N) Dave Benoit (Ret'd), CD

On a crisp, sunny Friday afternoon, just prior to the February long weekend, my spouse and I were able to attend a poignant and unique event. We received an unexpected invitation from **LCdr (Ret'd) Stephen H. Darrigan**, CD to attend his "Quilt of Valour" presentation ceremony.

On 14 February, an august congregation of current and former shipmates gathered on the Bridge of Juno Tower to witness the presentation of his beautifully hand-stitched and lovingly designed quilt. The presentation of this magnificent example of craftsmanship was made by **Rear-Admiral Josée Kurtz**, OMM, MSC, CD and the Quilts of Valour Halifax Representative **Ms. Rhoda Moore**, CD. The Formation Chief, **CPO1 Derek Godin**, MMM, CD, former shipmate to Stephen and many others gathered, were also in attendance.

As always, Stephen was humble, eloquent and witty in his acceptance remarks, noting that he was accepting it on behalf of all his former shipmates and on behalf of his family. He was truly honoured and humbled to have been nominated and selected for this special recognition. He remarked that he knew many others, more worthy than him, that could receive this amazing gift. Thanking the creator of this quilt, his Navy family, his children, and his spouse **Rowena**, and, while surrounded by his family and friends, he embraced the quilt and wrapped it around himself.

He highlighted the importance of his 35 years of service to the Royal Canadian Navy, in shaping his integrity, strengthening his character, and fostering his positive attitude. Several remarked that equally, he helped shape the character of the Navy and the Engineering profession in kind. He credited his years of devotion and perseverance developed during his service to the country, in helping to sustain him in his current situation. He recalled that "you can take the man out of the navy, but you can't take the navy out of the man" as he joyfully reflected on his many decades of service.

To be apart of this amazing and special event, the first experience for me, was remarkable. The crafter of this quilt, **Ms. Christie Hammel**, was on hand and was fortunate to experience firsthand the joy, pride and excitement that came with it.

Photo courtesy Darrigan Family

While Stephen is not the only engineer, or former service member, I know to have received such a quilt, it is the first ceremony I was able to attend. I don't know if everyone who has received such a gift, has had a similar experience, but if you are suddenly informed that you will receive one, you should seriously consider having an event to mark the occasion. It would be my observation that it helps the recipient, the family and awareness of the program. Indeed, it helps spread the magic.

Quilts of Valour – Canada Society, supports injured Canadian Armed Forces members past and present, with quilts of comfort. Starting in 2006 by an Edmonton quilter, **Ms. Lezley Zwaal**, she presented quilts to three Canadian Armed Forces members who were recovering in hospital from injuries they received in Afghanistan. It was her way of saying "thank you" and giving some comfort to these military members. Their mission "is to ensure that injured Canadian Forces members are recognized for their service and commitment to our country. We give this support through the presentation of quilts to comfort our injured past and present Canadian Forces members." Their homepage can be found at quiltsofvalour.ca and to request a quilt for someone you might know, can be found under "Eligibility Criteria".

Such a thoughtful and touching moment, heaped on to a thoughtful, loving, loyal and dedicated shipmate.

News Briefs

Technical Assist Visits on HMCS *Ottawa*: Meeting the Needs of an Aging Fleet

By Gabrielle Brunette

As Canada's naval fleet ages, the demand for Technical Assist Visits (TAVs) has been on the rise. This year alone, Fleet Maintenance Facility (FMF) Cape Breton has sent over three TAVs to support HMCS *Ottawa* (FFH-341) while on deployment. **Lt(N) Craig Plumb**, Deputy Program Manager 1, attributes the rise in TAVs to two main factors: the age of the ships and crewing issues. Older vessels experience more frequent technical failures, requiring additional support from shore-based engineering teams. Additionally, the reduction of available sea days in recent years, coupled with the frequent movements of crews from platform to platform, make troubleshooting complex issues more difficult.

Lt(N) Plumb also noted that, in recent history, at least four TAVs have been needed per deployment. Some of these involve intricate failures where multiple issues converge into a single problem, making diagnosis and repairs more complex. Coordinating a TAV is also a complex operation. Lt(N) Plumb emphasized the various logistical hurdles—securing port clearances, rapidly sourcing materials, and arranging transportation—that need to be taken into consideration when planning a TAV.

"One of the challenges we face on the West Coast is the Pacific Ocean itself," Lt(N) Plumb explained. The long travel days and limited flight options can make it more difficult to execute a TAV, especially on short notice.

Depending on the location of the TAV, the logistical picture can change significantly, requiring flexibility and collaboration across multiple actors. Close collaboration across FMF Cape Breton's travel, production, supply chain management, and engineering departments, as well as the ship itself, is required to ensure that personnel and materials are where they're needed, when they're needed.

Shane McClymont and **David Washington**, Project Leaders for HMCS *Ottawa*, emphasized the tight timelines their team often works with to execute a TAV. One of the recent TAVs for HMCS *Ottawa* required a rapid turnaround: a call was received on Thursday, and by Tuesday, a team was already on the ground in a foreign port.

While the program managers and project leaders play a crucial role in coordinating efforts and bringing everyone together, the success of each TAV relies heavily on the collective work of everyone involved. "There are so many people we need to thank for every TAV and making it all possible. It's truly a team effort—like a football team; a quarterback is nothing without the rest of the team," Washington said.

Photo courtesy Sailor 3rd Class Jacob Saunders, Canadian Armed Forces

HMCS *Ottawa* following the United States Carrier Strike Group during the replenishment at sea in the Indo Pacific Ocean during Operation HORIZON on 17 November 2024.

Despite the challenges with logistics and the tight timelines, Washington continues that the team takes great pride in their work.

> We're all supporting the sovereignty of Canada. It's about ensuring the Navy can meet their main goals—sailing, fighting, and defending Canada's interests around the world. It's a pretty cool feeling to know that we're directly supporting that, and I think everyone is really starting to share in that moment.

As the need for TAVs continues to grow, the team remains committed to refining processes, mentoring crews, and overcoming logistical challenges—ensuring that no matter where HMCS *Ottawa* or any other Canadian ship sails, it has the technical support needed to complete its mission.

CNTHA

NEWS (SUMMER 2025)

Canadian Naval Technical History Association

A Look Back at the RCN's 3"/70-Calibre Gun System

By LCdr (Ret'd) Brian McCullough, CD

Last fall, we featured the story behind the selection of the 3"/50-calibre bow gun for the *Protecteur*-class AORs (see *MEJ* 109). At one time or another, this short-barreled, twin-mounted weapon was carried aboard all of the RCN's 20 steam-driven destroyer escorts, half of which had a 3"//50-calibre fitted both forward and aft. The after Y-mount was later removed from all seven ships of the *St-Laurent* class when they were converted to DDH-class helicopter carrying escorts, as well as from four of the seven *Restigouche*-class ships when they were upgraded with an Anti-Submarine Rocket (ASROC) launcher on the quarterdeck. The two ships of the *Annapolis* class were originally constructed as DDHs, so never carried an after gun.

The remaining 10 steam-driven escorts — including all seven of the *Restigouche* class, and three of the four *Mackenzie* class — were fitted with a longer barreled 3"/70-calibre gun in the forward A-mount position when they were built. The exception was HMCS *Qu'Appelle* (DDE-264), which was the only steamer that carried two of the U.S. designed 3"/50s throughout its entire period of service. Both gun systems fired a three-inch calibre projectile, but the different barrel lengths of '50 calibres' (i.e. 50 x 3 inches, or 150 inches), and '70 calibres' (210 inches), respectively, gave rise to their 3"/50 and 3"/70-calibre designations.

The British twin-mount 3"/70-calibre system was initially designed by Vickers as secondary armament for the Royal Navy's *Tiger*-class cruisers. Like the 3"/50-calibre, it was a quick-firing, dual-purpose weapon that could be used against both air and surface targets, but had somewhat longer reach in both modes. The 1,000 m/s muzzle velocity of the 3"/70-calibre could propel a 6kg high-explosive projectile out to a range of nearly 18,000 metres at 45 degrees elevation, and more than 10,000 metres in high-angle anti-aircraft configuration. The British Mk-6 mounting could elevate the gun to complete vertical at 30 degrees per second, and train the weapon at 60 degrees per second. Targeting was facilitated by a Canadianized Mk-69 gunfire control system, coupled with the AN/SPG-48 X-band radar (later replaced with an SPG-515 radar during the DELEX refits).[1]

Photo by Brian McCullough

A retired RCN 3"/70-calibre gun, with an ASROC mount and 3"/50 gun in the background, on display next to the Canex at CFB Esquimalt, BC.

The 3"/70-calibre weapon featured an active water-cooling system for the barrels so that the gun could maintain a high rate of fire. While the gun was rated for 120 rounds per minute per barrel aboard the Canadian destroyer escorts, the maximum continuous rate was limited to about 90 rounds per minute to prevent overheating. Ammunition was delivered from the magazine below decks via chain hoists to the gun mount, where it was loaded by hand into hoppers to be transferred to continuously rotating feed rings that auto-loaded the gun. Crews likened it to the workings of a bottling plant, or old-style Coca-Cola machine. Spent casings were ejected forward from the base of the gun.

When I served aboard HMCS *Terra Nova* (IRE-259) in the mid-1970s, there was no end of satisfaction in watching as round after round of our dialed-in gun found its target on the gunnery range. However, more professional assessments question whether the dual-purpose 3"/70-calibre gun was entirely

(Continues next page...)

1. https://www.hazegray.org/navhist/canada/systems/firecontrol/

adequate in an anti-surface/shore bombardment role. According to former HMCS *Gatineau* (IRE-236) Combat Systems Engineer and CNTHA member **Ken Bowering**, the 3"/70-calibre was a great gun when properly maintained, albeit somewhat limited in its capability:

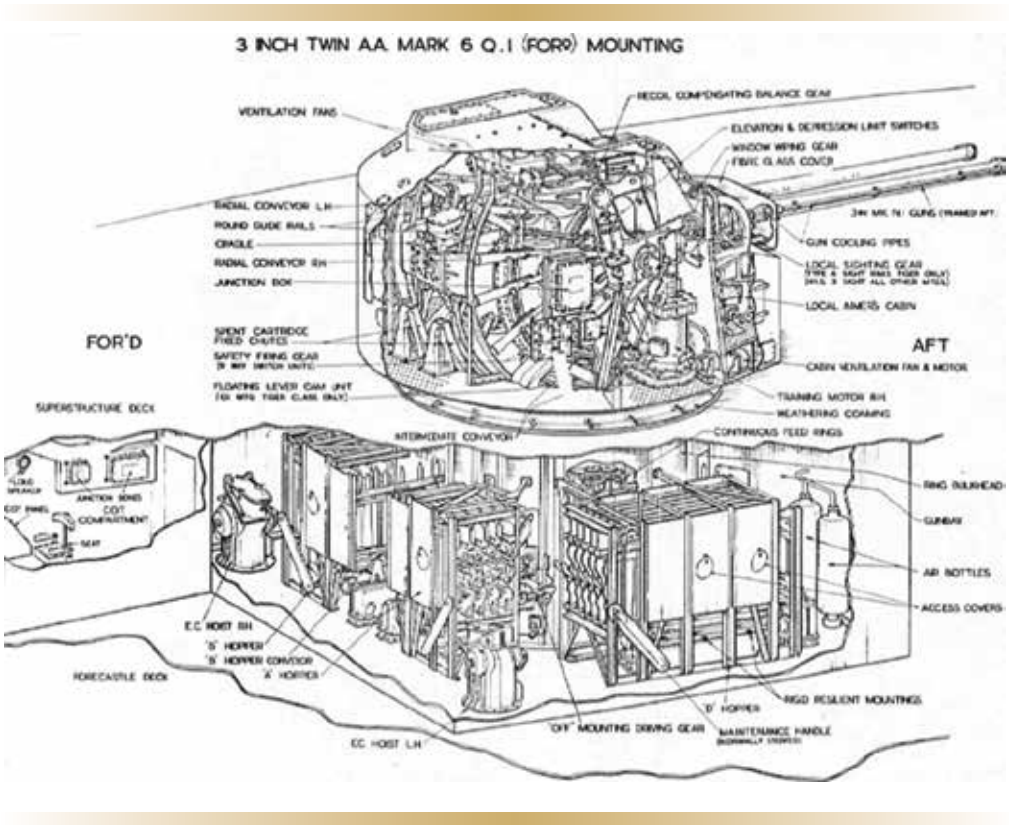
> The gun itself was okay against incoming air targets, but not very effective against large surface targets. Unlike the successes achieved by the RCN destroyers in Korea with their larger guns, the 3"/70-calibre had very little capability in shore bombardment operations because the trajectory was extremely flat over its range. A slight increase in elevation would send the projectile far beyond the intended target, and since the gun did not come with 'false range' tables, the projectile couldn't be 'dropped' in place. It really was just an AA gun.

It is interesting to note that when *Terra Nova* and HMCS *Restigouche* (IRE-257) were rapidly refitted with weapon upgrades for deployment to the Persian Gulf in 1990-1991 (see *MEJs 26 and 27*), both ships carried their original 3"/70-calibre guns into theatre.

The last of the RCN's 3"/50 and 3"/70-calibre guns retired with the steamers, but fortunately a number of these weapons can be seen at various museums and naval units across the country. The Naval Museum of Alberta in Calgary has both on exhibition, along with consoles from the SPG-48 tracking radar and Gunar fire-control computer that controlled these workhorse weapons.

CF Photo HSC-71-327-108

During HMCS *Terra Nova*'s IRE refit in the late 1960s, the after 3"/50-calibre gun mount was replaced with an ASROC system, but the longer-barreled 3"/70-calibre on the fo'c'sle was kept in service. The ship deployed to the crisis in the Persian Gulf with this same gun in 1990.



Gun diagram courtesy The Naval Encyclopedia