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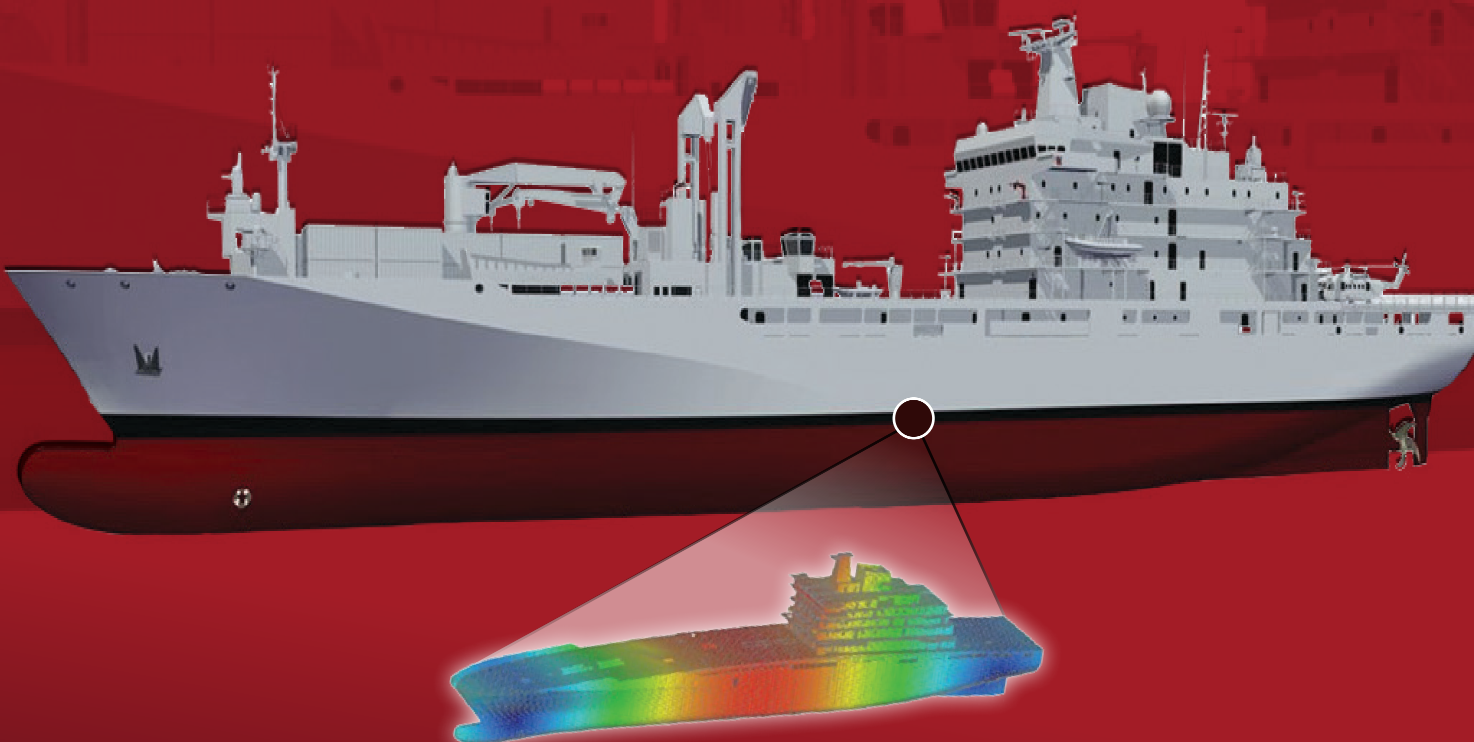
Maritime Engineering Journal

100
Since 1982

Spring 2022

40th Anniversary of Canada's Naval Technical Forum



Featured Content

Structural Fatigue: A Forward-Thinking Approach for the Joint Support Ship

CNTHA News Inside!

Canada

Canadian Armed Forces photo by Corporal Braden Trudeau

A Marine Technician's engineering change proposal for *Halifax*-class frigates could lead to significant financial savings and operational benefits for the RCN.

Story begins on page 21.

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Maritime Engineering Journal

(Established 1982)
Spring 2022

Commodore's Corner

Forum

Feature Articles

In celebration of the *Maritime Engineering Journal*'s 40th anniversary, these images of the future Joint Support Ship are set against a background of traditional ruby red.

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COMMODORE'S CORNER

Stability in all things

By Commodore Lou Carosielli, CD

A question came up at a recent town hall that got me thinking about "stability," and how it applies to the work we do. We don't have to look very hard to see the consequences of "instability" around the world, so it makes me even more appreciative of the things we are able to do as a technical community to keep the fleet, and ourselves, on as even a keel as possible.

It is no coincidence that some great examples of how we go about doing this are documented in the pages of this 100th edition of the *Maritime Engineering Journal*. I'll get to these in a moment, but it is worth noting that the very existence of the *Journal* itself is significant in this regard. As our longtime production editor explains in a special 40th-anniversary overview beginning on the next page, the *Journal*'s future was anything but certain during several rounds of government cutbacks over the years, and it took the determined efforts of some of my predecessors to demonstrate to the higher-ups that there was "value added" in maintaining this technical forum, *especially* when times were tough. The community did its part by stepping up with articles, commentaries and news items, all designed to keep the professional conversation going during some truly difficult periods. It is dedication like this that has allowed the *Journal* to continue publishing without interruption since 1982.

Stability in a more nautical sense is the theme behind our front cover feature — a forward-thinking approach to reducing risk associated with structural fatigue in the future *Protecteur*-class Joint Support Ships. As you'll see when you get to the News Briefs, the subject of structural fatigue was also an integral part of the discussion at this year's RCN Naval Architecture Conference. I think it is typical of the skills available in our community that we have teams of people who can work just as effectively with new construction as they can with ships entering the later stages of design life...plus everything in between.

In this respect, we offer two other examples of how the Navy depends on having access to a stable workforce of military and civilian members, and industry partners, who are all very good at what they do. The first describes an intricate gearing repair that highlights the close tolerances involved in repairing high-speed precision machinery, while

the second shows how **Master Sailor Nathanial Frid**'s familiarity with the low-pressure air (LPA) system aboard *Halifax*-class frigates could lead to significant financial savings and operational benefits for the RCN.

As a Marine Technician, MS Frid is well aware of the issues the Navy is grappling with to improve training and work-life balance for members of the amalgamated Mar Tech occupation (see my remarks in MEJ 98). I am happy to say that we are making progress, thanks in large part to some steady hands on the tiller by a select team of knowledgeable senior non-commissioned members. It goes without saying that the personal well-being of every single person in the RCN's technical support community is of supreme importance, and it is on this aspect of stability that I would like to close.

I mentioned "tolerance" as it relates to machinery aboard ship, but there is tolerance of another kind that is absolutely critical to the machinery of the Navy — the respect we hold for ourselves, and for one another. As we learn from our Forum coverage starting on page 7, **Honorary Captain (Navy) Jeanette Southwood** continues to offer her mentorship as a subject matter expert in addressing the challenges of equity, diversity and inclusion that we are striving to overcome in our own STEM workplace. We are thankful to her for this.

Stability in all things is a worthwhile goal at any time, and never more so than in the uncertain days ahead. I wish us all a speedy return to a kindlier existence.

Take care.

FORUM

The Amazing Story Behind 40 Years of the *Maritime Engineering Journal*

By LCdr (RCNR Ret'd) Brian McCullough
Production Editor

The long-running success of the *Maritime Engineering Journal* — the Royal Canadian Navy's flagship technical forum established in 1982 — proves that it is possible to "make soup from a stone."

In the old European folk tale, a hungry traveller invites villagers to add their own ingredients to his "stone soup," a simmering pot of water that contains nothing more than a smooth stone. Curiosity aroused, they eagerly contribute vegetables and a bit of salted meat, and are astounded by the tasty result. As they enjoy the soup together, one villager remarks, "and to think it was made just from a stone!"

It is a wonderful story of how inspired creativity can lead to greater community good, which in many ways describes the remarkable story of the *Maritime Engineering Journal*. Just as the magic of the soup lay in the cooperative nature of the enterprise rather than in the stone itself, what began as one person's idea for a semi-professional journal 40 years ago, crystallized and caught the imagination of the community to become the longest-serving branch periodical, in its class, still in continuous publication in the Department of National Defence (DND) and Canadian Armed Forces (CAF).

Apart from the specially funded Forces-wide information and safety publications that continue to serve the wider need, many other DND/CAF newsletters and magazines have come and gone over the years. From the very start, however, the leadership of the naval technical branch insisted that the *Journal* should set its sights on being in it for the long haul, and took the necessary steps to ensure this would happen. Everything is relative, of course, but it's probably safe to say that this 100th issue marks a significant achievement in that respect.

Having the extraordinary good fortune to have been part of this project since before it was even approved, I can say without hesitation that the *Journal* owes its longevity first to the steadfastness of its publisher — the Director General Maritime Equipment Program Management (DGMEPM) — and to the more than 1,300 members of community who have supported us with their articles, commentaries, news items and photographs over four decades. Their reward, I believe, goes well beyond simply seeing their work in print. In addition to reaching its primary audience of serving or retired RCN and DND naval engineers, technicians and support personnel, the *Maritime Engineering Journal* is enjoyed free of charge by an extended community of industry partners, foreign navies, and educational institutions worldwide.

Commodore Dennis Reilley in 1992.
The "father" of the *Maritime Engineering Journal.*

Beginnings

The spark that ignited the flame was **Cmdre (Ret'd) Dennis Reilley**. He retired in the 1990s, but when he was a commander and section head in the Maritime Engineering and Maintenance division (DGMEM) at National Defence Headquarters in 1978, he was already thinking about the benefits of having a Maritime Engineering (MARE) branch journal (see MEJ 28). The Navy was suffering serious attrition of qualified engineers and technicians to government civilian positions in the ship construction projects and to industry, and DGMEM was looking for incentives under a MARE Get Well Project to stem the outflow. Launching a semi-professional journal would certainly be timely.

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Production editor Brian McCullough at work at headquarters in 1991.

As Cmdre Reilley wrote me in 2012, "Once promoted Captain (Navy) and appointed as the Director of Marine and Electrical Engineering (DMEE) in 1979, I started working on creating a journal in earnest. It was easy for Cmdre Ernie Ball (DGMEM) to commit to it, as precedents existed throughout the CAF for other classification professional journals, and I was able to line up funding. Getting the *Journal* started remains one of the fondest memories of my four years in DMEE, and I am very pleased that subsequent generations have continued to support it. We could never have gotten the *Journal* published without your interest and enthusiasm early on."

In fact, it was **Lt(N) Robbie Robertson** who Capt(N) Reilley tasked to conduct a feasibility study into the possibility of publishing an in-house journal. I was on Class C Reserve service as the DGMEM divisional Training Officer, at the time, and although I was a navigation officer, not an engineer, Robbie knew that I was a writer, and had experience as the managing editor of the newsletter for the local Naval Reserve unit. Minutes after receiving his tasking, a somewhat perplexed Robbie swung by my desk to ask for advice on how to go about "making a journal." We sat down together and mapped out a rough plan, after which I wrote some initial print specifications so that he could get cost estimates for his study. I was 28 years old at the time, and had no inkling that I was actually charting what would become the focus of my life's work for the next 40 years.

On May 28, 1981, Capt(N) Reilley briefed the monthly Directors meeting on the positive findings of the study, and seven weeks later, on July 15, 1981, **Cmdre EC Ball** directed that a "MARE Newsletter" should be stood up as a forum to promote professionalism among marine engineers and technicians. An early run of the first issue featuring the newly designed MARE crest on the front cover (a story for later), was prepared in time for the June 1982 MARE Conference, and there was no looking back.

How much the *Journal* actually benefitted the MARE Get Well Project was difficult to quantify, but the increasing number of article submissions and subscription requests were pretty good early indicators of its value throughout the naval technical support community. In 1985, **Cmdre John Gruber** (Cmdre Ball's successor as DGMEM) emphasized this notion of the *Journal*'s importance by taking the bold decision to commit to employing a full-time production editor. As he put it to me, he wanted to "ensure the *Journal* had legs to last a very long time." In the years that followed, his successors (14 of them, so far) would do their part to both guide the *Journal*, and protect it against some very difficult rounds of DND budget cuts.

Leading the Way

Establishing a full-time editor immediately set the *Journal* apart from the many other branch periodicals, which often struggled to get their next issue out. Relieving the naval engineers of a burdensome secondary duty outside their normal area of expertise not only freed them up for the more technical work they were trained for, it allowed the *Journal* to begin taking on a leadership role within DG Information's oversight Periodical Review Committee, chaired by the amazing **Lise Bailey**. The professional editorial standards we set for ourselves soon became the model that other publications were encouraged to emulate, especially after we took the lead on committing to a fully bilingual format, starting with MEJ 16 in April 1998. This was actually before it was official policy to do so, and there's a story both behind how this transpired, and the effect it had across the board for DND/CAF periodicals.

At the time, the translation policy for periodicals simply stated that we should publish articles in whichever official language they were submitted. Even if we wanted to do more, a translation word-limit imposed on us made this impossible, but we were determined to see this through and pushed back. In what became known as the 1988 Editors Revolt, the *Journal* challenged the restrictive one-size-fits-all funding model for DND periodicals, and brought the other periodical editors on board with us to demand more flexible funding arrangements to accommodate our different types of publications. We also insisted on having unlimited access to DND Translation Services to allow full translation of our magazines and newsletters. Needless to say, this woke a few people up, and the translation requirement policies were soon rewritten to better reflect the Government of Canada's stance on official bilingualism. Things just needed a little push in the right direction.

Over the years, the *Journal* would get involved in a number of other initiatives, such as joining forces with *Sentinel* magazine to make the case for bringing desktop publishing into DND, redeveloping the syllabus for the annual DND Periodical Editors Course, and entering into a synergistic publishing partnership with the Canadian Naval Technical History Association (CNTHA). These were all worthwhile endeavours that not only upped our own game, but helped others along as well.

On several occasions we were proud to be recognized with Achievement Awards for Editing and Design from the Eastern Ontario Chapter of the International Society for Technical Communication, and with Commander RCN Commendations for the outstanding success of our editorial teamwork. Such acknowledgments affirmed we were headed in the right direction, but from our standpoint the real tip of the hat was always reserved for the people who penned the articles we had the privilege of working with.

The Stories

When it comes to the variety of material that we publish, **Blaine Duffley** (a retired Combat Systems Engineer, and current PM for the Joint Support Ship) perhaps described it best. During his briefing to the 2022 Central Region Naval Technical Seminar in March, he mentioned how lucky the community was to be working in an environment that offers so many different employment opportunities. How right he was, and it is the stories of the activities associated with these opportunities that we continue to share through the pages of the *Journal*.

On that note, our policy has always been to freely share what we publish, asking only that people acknowledge the source, as a NATO logistics magazine did when they reprinted **CPO1 Bob Steeb**'s timeless Forum article, Truth versus Loyalty (MEJ 39). Another defence publication was so inspired by Bob's message that they took some licence and created a "free abridgement" of it for their readers to clip and hang in their cubicles at work. No harm, no foul, I guess.

In a fun bit of convergence, the most-requested article to date is the "HMCS *St. John's* Maintenance Capability Study" (MEJ 50), a piece co-authored by the *Journal*'s current publisher, **Cmdre Lou Carosielli** (DGMEPM), and **Joel Parent** (currently the Weir Canada civilian site manager for the Naval Engineering Test Establishment). During their Head of Department tours more than 20 years ago, the eight-month study they conducted aboard their *Halifax*-class frigate validated what many people in the technical support community already knew to be true — that our seagoing technicians don't have enough time for maintenance.

Still other articles have been reprinted as part of student preparatory packages for high-level defence and peacekeeping courses, and it was always nice seeing the authors' work valued in this way. Two of these were reprinted from our special coverage on "Cambodia – The Forgotten Mission" (MEJ 34), written by **LCdr Ted Dochau** and **LCdr Rob Mack**...which leads me to mention a sad epilogue.

Four years after we ran the Cambodia articles, Rob Mack buttonholed me at the spring 1999 Naval Technical Seminar in Halifax. He had recently returned from a six-month reconstruction deployment to war-scarred Bosnia, and I suspected the envelope he was carrying likely held his next travelogue. If there was one thing this intrepid CSE could be counted on for, it was his willingness to use the *Journal* to document his overseas experiences for the rest of the naval technical community.

As he pressed the envelope into my hands, he simply thanked me for doing a great job, and said, "Would you please see this gets published in the *Journal*." I gave him my assurances, and with that he abruptly turned and left. Our meeting had lasted all of 15 seconds. I opened the package to find photographs of shell-torn buildings, and an article to go with them. It had clearly been a tough deployment, and I was saddened to learn of his accidental death at age 42 just a few months later. The editorial committee honoured his request, and that fall we published his final article, "Bosnia: Greetings from the Front!" (MEJ 48.)

Many stories have moved me deeply, but none more so than one we ran on the 50th anniversary of the RCN's worst peacetime disaster — the 1969 HMCS *Kootenay* gearbox explosion (MEJ 91). Listening to *Kootenay* survivor **Allan "Dinger" Bell** (an AB Stoker at the time) describe his horrifying escape from the burning engine room, and learning the extent of the physical and mental injuries that dog him to this day, made this the most difficult story I have ever worked on for the *Journal*.

Thankfully, there have been some really fun stories as well, such as the Nine-Minute Writing Challenges (MEJ 63/64). There was also the one about RCN veteran **Bill Bovey's** Korean War medical discharge certificate signed by "Surg.-Lt. Joseph Cyr" — in reality, Ferdinand Waldo Demara, the Great Impostor (MEJ 55). On a related note,

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some of you will be familiar with retired CSE **Cdr Roger Cyr**, whose many articles have appeared in the *Journal*. Despite having the same last name as the one Demara was masquerading behind, Roger's only connection to the Great Impostor was that they served aboard the same ship — HMCS *Cayuga* — about a decade apart. Roger wrote about the ribbing he took over this in MEJ 38.

We have also run countless great technical articles, including an Engineering Incident story (MEJ 25) that you can read in our new feature on page 26 that takes a second look at stories from our archives. Our former associate editor **Tom Douglas** suggested we call the feature *Déja vu!*

One of the other initiatives we are promoting is for more NTO-NCM author teams, much like the duo from HMCS *Shawinigan* whose story made the front cover of our last issue (MEJ 99). Thirty years earlier, I collaborated with **CPO1 Jim Dean** on a short Looking Back piece on HMCS *Fundy*(I) (MEJ 24), which gave us a chance to talk about many things beyond what we were doing for the article. It was a wonderful experience, and I encourage everyone to look for opportunities like this because, in the end, the story of the *Maritime Engineering Journal* is one about people working together.

Looking Forward

The *Maritime Engineering Journal* remains the only publication in existence designed to meet the specific needs of Canada's military/civilian naval technical support community. As such, it is a valuable and authoritative source of reference on Canadian naval engineering activities and perspectives as presented by the engineers, technicians and support personnel themselves. By reflecting the goals, ideals and traditions of the profession, it strengthens the ties that hold the membership together, fostering a more effective work force.

A publication like the *Maritime Engineering Journal* obviously doesn't simply appear every few months for 40 years without a lot of people doing their bit to keep the machinery running. I do my part to manage and produce the editorial content as best I can, of course, but I'm talking about the long list of people who work in less visible capacities to ensure that each new issue of "Canada's naval technical forum" is one we can be proud to call our own: They are the editorial advisers and subject matter experts, the project and financial managers, the translation specialists, the graphic artists and photographers, the print services partners and web support teams...all of whom deserve recognition.

Thanks also go to our current d2k Graphic Design & Web production team consisting of manager **Daniel Dagenais**, and graphic artists **Marie-Josée Lemaire** and **Annie Guindon**. These are the people who double down to produce the effective layouts for each issue, bringing their creative solutions to the page, and manage the final print and web production. We regrettably didn't get an opportunity to bid a proper farewell to Tom Douglas, who left the *Journal* team late last summer to focus on another DND branch periodical. We thank him for his time with us, and wish him well. I miss our interesting and often complicated discussions on editorial points of order.

As the *MEJ* enters its 41st year of uninterrupted publication, I feel certain that the people who envisioned and gave life to this extraordinary magazine would be heartened by the steady stream of new feature articles and Forum perspectives that continue to arrive from all quarters. Together, these give the *Maritime Engineering Journal* its powerful voice, a reflection of the high sense of mission and purpose held by the community it serves.

Forty years ago, a torch was lit that continues to burn brightly thanks to the unfailing stewardship of the office of the Director General Maritime Equipment Program Management. The future can never be certain, but it isn't too difficult to believe that there is someone out there now who will be cracking open the bottle of Champagne on behalf of the entire naval technical support community when the *Maritime Engineering Journal* marks its half-century of publication in 2032.

For myself, I will be forever thankful to have been part of this bold and wonderful experiment.

Acknowledgments

My thanks to **Erin Cruse**, **Ashley Evans** and **Wendy Wagner** for their valuable assistance in tabulating a wealth of data relating to the archived editorial content of the *Maritime Engineering Journal* (est. 1982), and *CNTHA News* (est. 1997). The important baseline information they have gathered will prove useful for historical research, and for supporting decisions taken by the Editorial Board in the years ahead. Bravo Zulu on a job well done!

FORUM

A Conversation with Honorary Captain (Navy) Jeanette Southwood: Speaking the Language of Equity, Diversity and Inclusion

By Capt(N) (Ret'd) Seana Routledge

As a woman working in Science, Technology, Engineering and Mathematics (STEM), it was wonderful to be able to have a conversation with someone who not only understands the shoes many of us walk in throughout our lives and careers, but who can speak so clearly to the many barriers that impede the path toward a more equitable, diverse and inclusive workplace. The challenges of systemic discrimination felt by under-represented groups within STEM, and elsewhere in workplaces across Canada, is real, and addressing these challenges head on is an essential step in creating a workplace that best represents and takes advantage of the rich diversity Canadians have to offer.

The Canadian Armed Forces and the Department of National Defence have made the elimination of discrimination a top priority, and last October it was a great pleasure to welcome Ottawa-based engineer and **RCN Honorary Captain (Navy) Jeanette Southwood** as our guest speaker for an online naval technical professional development session to speak about creating a workplace that is welcoming to all.

HCapt(N) Southwood is Vice President, Corporate Affairs and Strategic Partnerships, with **Engineers Canada**, the national organization of the 12 engineering regulators that license Canada's more than 300,000 members of the engineering profession. Her portfolio includes: equity, diversity, and inclusion (EDI), outreach and engagement, communications, government relations, public affairs, and public policy. As an immigrant from South Africa, and as a Black woman working at the top of her engineering profession, HCapt(N) Southwood was able to speak to us from both a personal as well as a corporate perspective on the importance of EDI within STEM workplaces, and to the strategies for removing barriers that limit people's full potential.

As was reported earlier in the *Journal*, in late 2020 the Minister of National Defence appointed this extraordinarily gifted woman and role model as an RCN Honorary Captain, affiliated with the Naval Technical branch, in recognition of her outstanding professional credentials and deep personal accomplishments. In addition to the

Photo by LCdr Cindy Hawkins

HCapt(N) Southwood during her West Coast dockyard familiarization tour in 2021.

expertise she brings to our community, HCapt(N) Southwood is also learning from us. She fulfills an important role for the Minister by raising awareness about the RCN's unique STEM workplace environment across the wider engineering community in Canada.

Our virtual meet-up with HCapt(N) Southwood came about as part of a mentoring and networking initiative for Women Naval Technical Officers (WNTOs) that I have been developing with senior WNTOs for the past few years to encourage community and connection. When interest was expressed in having a professional development session on the challenges facing women pursuing engineering and technical careers in the Navy, I invited HCapt(N) Southwood to speak to us, knowing this award-winning engineer was

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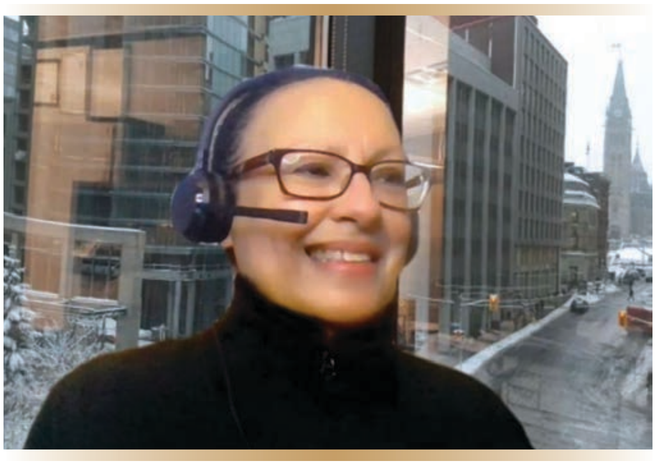

highly skilled in speaking to the overarching topic of EDI in the workplace.

Her response to our invitation was enthusiastic, and on Oct. 25, 2021 we presented "*A Conversation with HCapt(N) Southwood*" over MS Teams, with people joining the discussion online from across the country. The attendees included a cross-section of the Defence community, including representatives from the Defence Women's Advisory Organization (DWAO). HCapt(N) Southwood is an excellent role model for military and civilian technical personnel of all ranks and all genders, and our session with her was outstanding. For myself, the key takeaways that day were:

- Under-represented groups should not be burdened with "fixing" EDI/cultural problems. In order for systemic barriers to be removed, majority groups need to take a leadership role in addressing discrimination, and becoming allies and sponsors;
- The RCN's technical branch has expertise in many areas, but we are not experts in how to initiate meaningful EDI culture change. For this, we need the guidance of subject matter experts in EDI;
- Change leadership and change management are crucial elements in establishing lasting culture change; and
- Formal mentorship programs are highly useful tools in achieving organizational goals.

Because the Oct. 25 session was not recorded, DGMEPM Unit Chief **CPO1 Monika Quillan** suggested that an upcoming *Journal* interview with HCapt(N) Southwood might revisit our highly successful event. We gathered what notes we had and passed them to production editor **Brian McCullough**, who spoke with Jeanette on Dec. 7. In the Q&A segment that follows, HCapt(N) Southwood describes the key actions that Engineers Canada recommends to any organization looking to establish substantial EDI culture change in the workplace.

We thank HCapt(N) Southwood for her kind cooperation in this endeavour, and sincerely hope that people will feel encouraged to become more proactive in establishing a cultural "new normal" that is defined by a willingness to address discrimination, and an acceptance of equity, diversity and inclusion in all aspects of our lives.

In January, following 25 years of naval service, Capt(N) (Ret'd) Seana Routledge transitioned to civilian employment within DND. She continues to remain active within the women's NTO community, and in promoting Equity, Diversity and Inclusion in DND.

Photo by LCdr Cindy Hawkins

FORUM

Key Actions for Establishing a Workplace Culture of Equity, Diversity and Inclusion:

A *Maritime Engineering Journal* Interview with
HCapt(N) Jeanette Southwood
Vice President, Corporate Affairs and Strategic Partnerships, Engineers Canada

[**Editor's Note:** Engineers Canada (https://engineerscanada.ca/) has developed research-based guidance for STEM employers working to promote meaningful EDI culture change in their workplaces. HCapt(N) Southwood champions this initiative on behalf of Engineers Canada.]

[MEJ]: The Canadian Armed Forces (CAF) has prioritized the establishment of significant culture change with respect to EDI, including the elimination of organizational sexism and systemic racism. How do these efforts align with current best practices?

[**Jeanette Southwood**]: During my familiarization tour of Royal Canadian Navy ships and facilities on the West Coast last November, I had an opportunity to learn more about what the Canadian Armed Forces is doing to address the urgent need for EDI culture change in the military. A virtual presentation to the Naval Engineering Council by engineering Cmdre Jacques Olivier — Director General Professional Military Conduct — reassured me that what the CAF's Chief of Professional Conduct and Culture (CPCC) organization is doing certainly parallels what Engineers Canada has seen needs to be done in all organizations.

What underpinnings are necessary for establishing successful, lasting transformation in EDI culture?

A diversity of ideas, perspectives, experiences and people is critical to the success of any endeavour, including the EDI goals of Canada's military, and I am proud to have an opportunity to help where I can as an Honorary Captain (Navy) within the RCN's technical branch. Achieving success broadly involves strengthening peer networks, and forging bonds with social, professional and technical networks.

Engineers Canada also recommends specific key actions that employers can take to increase the meaningful representation of women and other under-represented groups in their organizations. What are these?

1. *Commitment from Leadership:*

The first thing, of course, is to ensure there is commitment to culture change from within the leadership — and by "leadership," we mean the board of directors, the people working at very senior levels, and other senior groups that would influence the direction of an organization. Commitment from the leadership has to be the first step in changing the culture of the workplace to one that is equitable, diverse and inclusive.

2. *Create an Action Plan:*

It is also important to create an action plan that has identifiable success points on the path to EDI culture change. Women and other minority groups are skeptical of organizations that pay lip service to supporting better representation in engineering culture change without actually doing anything concrete. It's one thing to *say* your organization supports increasing numbers and welcomes people from under-represented groups, but it's another thing to actually have a plan in place that monitors progress in a transparent way. For this reason, action plans need to be integrated with communication plans. Glass ceilings are real, and organizations must openly demonstrate that increased representation of under-represented groups is happening at all levels of the workplace, and not only in entry level positions.

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3. *Provide the Necessary Resources:*

Finally, changing the EDI culture inside an organization cannot *and should not* be left to under-represented groups to figure out for themselves. Along with commitment from the leadership to make positive change, and the creation of an action plan to roll this out, EDI initiatives must have the commitment of sufficient financial and human resources to execute the action plan successfully. Something I observed early on in my career was that often when an organization wanted to make cultural change (usually having to do with women in the workplace), money would be provided for snacks, and a room would be set aside to allow the women to talk about how things could be changed. But without a commitment from the organization to hire subject matter experts, or to involve a senior leader to champion this work in concrete ways, what they were funding could essentially be considered a coffee break or networking session. This isn't good enough in today's workplace. Enough money has to be set aside to bring in the right people to guide the organization through what can be a complicated and stressful cultural evolution, and to support the maintenance of a strong EDI workplace going forward.

What parting thoughts would you like to leave with us?

Through my association with the RCN as an Honorary Captain (Navy), Engineers Canada is sharing the news with Industry that the Canadian Armed Forces and Department of National Defence are making strides toward changing the professional conduct and culture inside the military under the inspired leadership of LGen Jennie Carignan and her CPCC team. Something that our STEM professional partners have come to understand is that there are quantifiable corporate advantages in supporting an EDI-positive workplace, and it only makes sense. When people see that an organization is actively supporting equity, diversity and inclusion in all aspects of its operation, they will be eager to join such an organization — and remain with it. Everyone wins.

https://engineerscanada.ca/news-and-events/news/highlighting-the-role-of-engineers-in-the-royal-canadian-navy

(From Your Navy Today: 2021 in Review)

While our day-to-day business continues, we will continue to work hard to change the culture within the RCN to one that is more equitable and safe. The RCN is determined that as an organization, we must bring about progressive change – driven by the passion of committed individuals and in the spirit of safety for all, optimism, openness and trust.

And we all know this: culture change is complex work that requires dedicated, deliberate and sustained efforts. We will continue with the implementation of Gender-based Analysis Plus (GBA+) into existing policy, governance, procurement and human resources. GBA+ is the analytical tool used in the Government of Canada to assess the potential impacts of policies, programs or initiatives on diverse groups of women, men, girls and boys by taking into account gender and other identity factors such as age, education, language, geography, culture and income; this is the tool that will help us unpack and remove systemic barriers that exist within our organization.

Although there is still much work to be done, we have already implemented new initiatives to move us in the right direction.

For example, the RCN's Diversity & Inclusion (D&I) Advisory Council was created to support increased information flow between RCN senior leadership, Defence Advisory Groups, Naval Reserve Diversity and Inclusion Command Advisory Teams, Honorary Naval Captains, and Champions. Their insight has helped the RCN Diversity & Inclusion Team to better prioritize initiatives across the RCN.

The forthcoming RCN Diversity and Inclusion website will provide RCN members at all levels a centralized database of resources, which will provide relevant information, policy and directives regarding employment equity, diversity, inclusion and GBA+.

FEATURE ARTICLE

Structural Fatigue: A Forward-Thinking Approach for the Joint Support Ship

By Jonathon Williams, Martin Fuller, and LCdr Antony Carter

As the saying goes, nothing lasts forever. Unfortunately, ships are no different. As vessels age, the ability of a ship's structure to resist imposed stresses diminishes. The limited assortment of tools that are available to technical authorities, combined with a large number of uncertainties, make it difficult to accurately assess the remaining life of a ship's structure. The result is that operational authorities assume a higher degree of risk when operating older vessels. The Joint Support Ship (JSS) will be provided with additional tools which will enable technical authorities to make more informed assessments of the risk associated with operating these vessels as they approach the end of their design life.

Design Life

Design life refers to the period of time that a vessel is intended to be in service, and able to complete the tasks it was designed to accomplish — aided by maintenance, repairs and refits. Selection of a design life usually requires a trade-off between structural robustness and other capabilities such as speed, endurance, and armament, to name but a few. In modern warship construction, the design life typically ranges from 25 to 35 years for large seagoing ships, but in some cases can exceed 40 years. For example, the United States Navy's *Nimitz*-and *Gerald R. Ford*-class aircraft carriers have a planned service life of 50 years (U.S Navy Office of Information, 2021).

A ship's design life is dependent on several factors, one being the consideration of the various modes of failure possible for the ship's structure, which is achieved through the application of what is known as "limit states design." Simply put, a limit state is defined by the description of a state in which a certain structural member, or an entire structure, fails to perform its intended function. The four most common limit states that are considered in ship design are:

1. Accidental Limit State (ALS), which considers structural damage resulting from accidents such as collisions and fires;
2. Ultimate Limit State (ULS), which considers failure mechanisms such as buckling and yielding;
3. Fatigue Limit State (FLS), which considers failure resulting from fatigue damage; and
4. Service Limit State (SLS), which considers structural damage from normal in-service operations (Hageman, et al., 2014).

Recently, as the Royal Canadian Navy (RCN) fleet continues to age, there has been an increasing amount of attention paid to the consideration and understanding of the fatigue limit state.

What is Fatigue?

Fatigue is a failure process — a function of the stress amplitude applied to a structure, and the cycles in which the stress is repeated (Callister & Rethwisch, 2014). Imagine bending a paper clip. The clip can be bent once and remain intact, but given enough repetitions it will crack and break. The graphical representation of stress amplitude vs. number of cycles experienced until failure is known as the S-N curve, an example of which is shown in Figure 1. (Steel used in the construction of the JSS would follow a similar curve as 1045 steel.)

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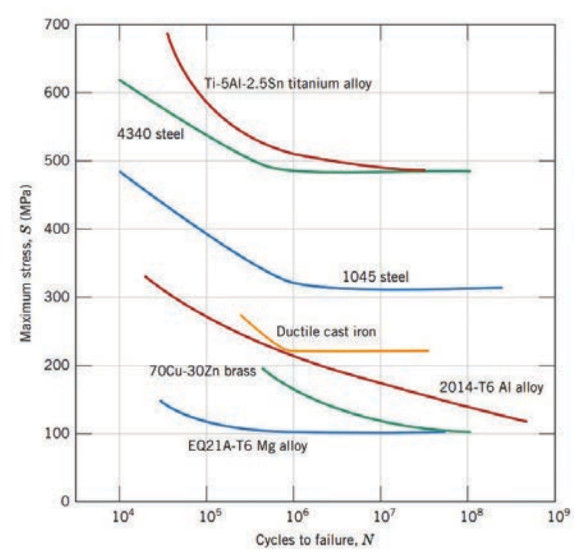

Figure 1. S-N curves for various materials. (Callister & Rethwisch, 2014)

Fatigue is characterized by cracking that takes place in three distinct phases: crack initiation, crack growth, and structural failure. In the *crack initiation* phase, stress applied to a material that is large enough to induce fatigue causes a microscopic crack to form at the maximum point of stress within the material, typically at the point where there is a concentration of stress, or a defect. During the *crack growth* phase, the crack propagates with each repeating stress cycle until the crack is so large that the remaining intact portion of the material fails upon the next application of the stress. The result is *structural failure*. Millions of cycles might be required to reach this point, as the actual number of cycles depends on the magnitude of the applied stress, the type of material, and other factors (Sieve, Kihl, & Ayyub, 2000). However, if the frequency of the stress cycles is high, fatigue failure can occur relatively quickly (Callister & Rethwisch, 2014).

Stress concentrations are found throughout ship structures on both the global and local scale. Global stress concentrations are commonly associated with significant changes in geometry, or discontinuities, such as deck openings, superstructure terminations, and knuckles. Local stress concentrations occur in both base materials and weldments. For the former, areas such as sharp corners and transitions, and plate edges are common areas of stress concentrations. For the latter, it is common for stress concentrations to occur along the many kilometres of longitudinal, transverse, and vertical welds that connect the various pieces of a ship's hull, often as a result of detail design decisions and weld defects (Sieve, Kihl, & Ayyub, 2000).

Stress concentrations can also result from localized and general corrosion resulting from exposure of unprotected structural surfaces to the marine environment. Surfaces may become unprotected if they are not adequately or properly coated, or if protective coatings have been damaged (Callister & Rethwisch, 2014).

Ships experience many forms of cyclical stress, with the dominant source being from wave-induced cyclical loads (Glen, Dinovitzer, Paterson, Luznik, & Bayley, 1999). The number of cycles in this environment can be in the order of millions of cycles per year, and can be composed of a wide range of amplitudes. Other sources of cyclical loading include vibrations from machinery, propeller-induced hull vibration, and the motion of fluid within tanks (Sieve, Kihl, & Ayyub, 2000).

Fatigue Life

Fatigue life refers to the time taken to repeat the necessary cycles for a material to fail due to fatigue. For example, if a material can sustain 20 cycles of a load until failure, and the load is repeated at one cycle per minute, then the fatigue life of the material would be 20 minutes. The same principle can be applied to assess the fatigue life of ship structures.

Although ship structures contain numerous types of structural details, to predict a ship's fatigue life it is common to base the prediction on a single detail, or on a series of structural details that are prevalent in the ship's structure. This detail will determine the limit on fatigue life, as more robust parts of the ship's structure will have a longer fatigue life. In general, the following procedure is required to predict fatigue life:

1. Determine the loads that are expected to act on the structure, and the resultant response of the ship;
2. Determine the internal stresses in the ship's structure based on the expected loads;
3. Select a suitable S-N curve for the structural detail(s) of interest; then
4. Compare the applied stress cycles against the stress cycles to cause failure (Sieve, Kihl, & Ayyub, 2000).

The loads that will act on the ship's structure depend on the operational and environmental profile of the ship. The operational profile is defined by the number of days the ship spends at sea, the ship's speed and heading when at sea, and the time that the ship will operate in different combinations of speed and heading in different wave conditions. The environmental profile is defined by the height and period of waves that will be encountered during the vessel's service life, and the probabilities of encountering different wave conditions. Figure 2 shows the daily position of HMCS *Iroquois* (DDH/DDG-280) from 1972 to 2009 based on log books; this data can be used to estimate the environmental profile of the ship.

A ship will respond differently to waves with different characteristics. The response of most importance when determining fatigue life is vertical bending moment. Using

Figure 2. Daily positions of HMCS *Iroquois* from August 1972 to July 2009. (Smith, 2017)

the operational and environmental profile of the ship, the lifetime vertical bending moment histogram can be assessed. With this histogram, the internal stresses in the ship's structure can be theoretically estimated through "hand" calculations, or by using tools such as finite element analysis for more complex structures. A stress range histogram can be determined at the location of the detail of interest.

S-N curves for structural details can be obtained from a number of sources such as building codes and design guides. In some cases, it may be necessary to conduct experiments in order to determine the S-N curve for the detail of interest.

The prediction of fatigue life is not an exact science. Several assumptions can lead to uncertainty, such as the assumption that the fatigue behaviour of a structural detail in a laboratory environment will exhibit the same behaviour when integrated into the ship's structure. The quality of construction of a ship also has a significant impact on the resultant stresses in the structure, and therefore the fatigue life (Sieve, Kihl, & Ayyub, 2000). In addition, the methods used in the welding and fitting of ship structures could result in elevated residual stresses, which when superimposed with the applied cyclic stresses could accelerate fatigue in the affected ship structures.

Current Approach for Monitoring Fatigue

Historically, structural fatigue in RCN vessels has been monitored through hull surveys, which are intended to inspect areas where fatigue can occur, and identify where repairs are required. Hull surveys, while necessary to understand the material state of a ship, represent a more reactive approach when it comes to monitoring fatigue, given that when cracks are identified during surveys, fatigue has already occurred. When cracks are discovered, they are already typically several centimetres long, and extend through the thickness of plating as shown in Figure 3.

Recent efforts within the RCN to better understand fatigue have included an assessment of the remaining fatigue life of the former HMCS *Iroquois.* Defence Research and Development Canada (DRDC) conducted an analysis of connection details removed from the ship during disposal (Huang, 2021).

Figure 3. A 30-mm crack found on the web of a girder aboard HMCS *Ville de Québec* (FFH-332). (Huang, 2021)

Joint Support Ship

The lead ship of the future *Protecteur* class is currently being constructed at Vancouver Shipyards Co. Ltd., in North Vancouver, BC. Figure 4 shows the progress of the construction of the ship, which will have a design life of 30 years. Once delivered to the RCN, the *Protecteur* class will be maintained to American Bureau of Shipping (ABS) classification standards. However, to augment the hull survey regime required by ABS, the *Protecteur* class will be delivered with several additional tools for actively assessing fatigue life. Light Structures AS, a global supplier of ship structural monitoring technology headquartered in Oslo, Norway, will install a hull monitoring system (HMS) in each ship. Furthermore, material and weld samples from the fabrication of key areas of the ship's structure are being collected during the build process.

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Figure 4. The future HMCS *Protecteur* under construction at Vancouver Shipyards Co. Ltd in August 2021. (Seaspan Shipyards, 2021)

Hull Monitoring System

An HMS can be used to support fatigue life assessments by providing stress range histograms for areas of particular interest in a ship's structure. The technology is not new. Hull monitoring systems have been installed in the United States Coast Guard's Legend-class national security cutters (Hageman, et al., 2014), and one was recently installed aboard HMCS *Montreal* (FFH-336). However, the future *Protecteur* class will be the first class of RCN vessel to be fitted with an HMS at delivery. This will enable an accurate understanding of the stresses imposed on the structure from the very beginning of service life, something that can otherwise only be estimated.

The HMS for the Joint Support Ship will function by transmitting light through fibre-optic cables to fibre-optic strain sensors located in select positions on the ship's structure. The sensors reflect a spectrum of light corresponding to the distortion of the structure, data from which can be analyzed and used to determine the stresses on the hull (Figure 5). The JSS HMS will also include two sets of three accelerometers oriented along the longitudinal, transverse, and vertical axes of the hull, as well as a six-degrees-of-freedom motion sensor. The output from these devices will enable an understanding of the ship's motions due to wave conditions (Light Structures AS, 2019). The locations of the strain sensors, accelerometers and motion sensor on the JSS are displayed in Figure 6.

While the primary intent is that the data collected from the HMS, through analysis, will enable a more accurate assessment of platform end-of-life, the exact nature of how this data will be used remains to be determined. Some investment will be required to either develop the necessary skills within DND, or contract out for them, in order to

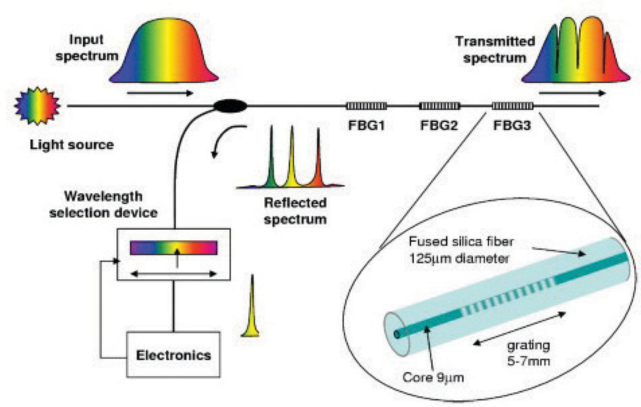

Figure 5. The HMS fitted in the future *Protecteur* class is a SENSFIB Hull™ Stress Monitoring System that uses Fiber Bragg Grating (FBG) sensors in the core of an optical fiber that strongly reflect one wavelength (or colour) of light which can be configured to derive stress in the vessel's structure. (Light Structures AS, 2022)

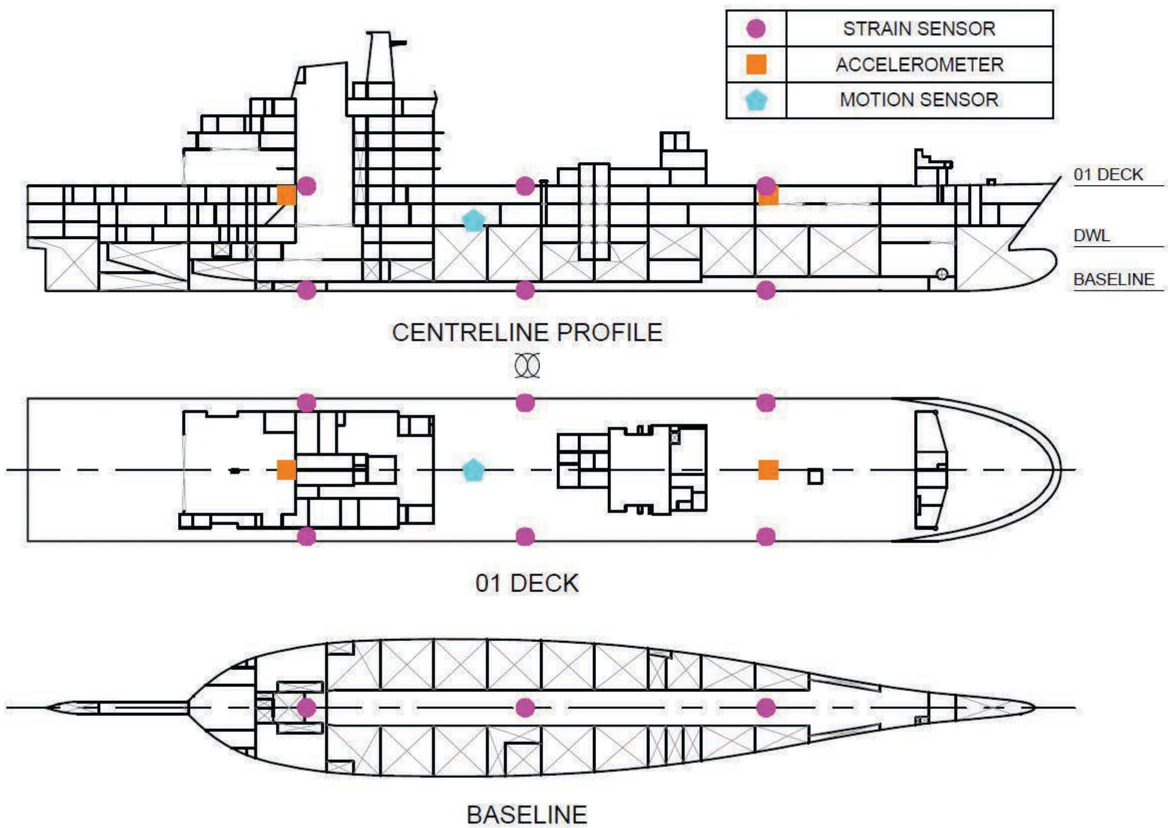

Figure 6. Strain sensor, accelerometer, and motion sensor installation locations on the Joint Support Ship.

collect and analyze the data to provide meaningful results. The data could help inform a number of decisions, including whether there is a need to perform hull surveys beyond the prescribed classification society regime should the JSS encounter conditions outside the expected operational and environmental profile. The collected data could also show how quickly fatigue damage is accumulating, and thereby assist decision-making regarding the periodicity of performing hull surveys. Finally, the data could support a number of parallel initiatives within DND, including:

1. Supporting the validation of numerical and theoretical models used to predict fatigue life;
2. Supporting the development of a digital twin of the vessel which could:
   a. Provide technical agencies a more holistic understanding of the material state of the JSS; and
   b. Enable simulations to be performed to determine fatigue states in localized structure, and thus enable more targeted hull survey regimes.

Material Samples

Given the significance of ship-construction materials in determining the fatigue life of the ship, baseline material and weld samples are being collected during the construction of the JSS. The steel samples will include both plates and profiles for all structural steel grades used in the design, with the thickness and width determined from median figures for each steel type used. Samples of profiles and weld coupons taken from JSS, which can be seen in Figure 7, are being shipped to the Quality Engineering Test Establishment (QETE) in Ottawa. The Directorate of Naval Platform Systems (DNPS 2) and QETE have a number of experiments they are planning to conduct upon receipt of the samples. The remaining samples will be stored under temperature- and humidity-controlled laboratory conditions until they are needed. These samples could be analyzed by QETE in the future to confirm assumptions made regarding the fatigue behaviour of the materials and weldments used in the construction of JSS, and allow more accurate S-N curves to be developed.

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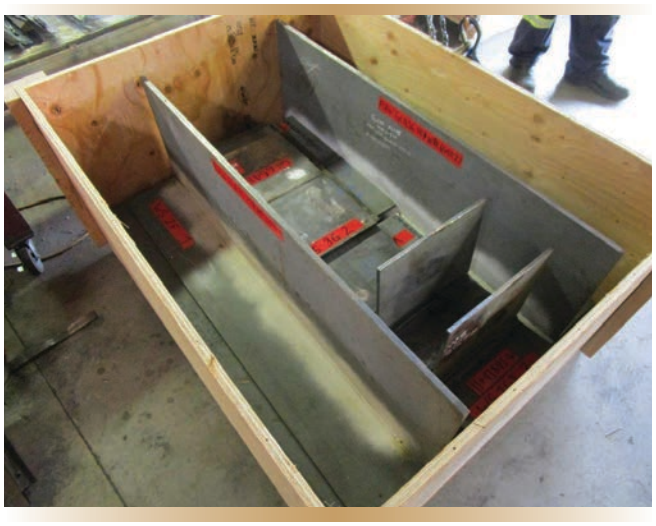

Figure 7. Material and weld samples from the future HMCS *Protecteur*.

Conclusion

Condition-based assessments have enabled the RCN to extend vessels beyond their design life in the past, but predicting fatigue failure using these methods remains difficult. This leads to decisions that carry increased risk, or result in inflated safety margins being applied to account for the uncertainties.

While the hull monitoring equipment itself is not new or innovative, the fact that the JSS will be equipped with this system at delivery is a novel approach for the RCN. Despite the work that remains to be done to determine how best to utilize the collected data, it should at a minimum provide technical authorities with greater insight into the fatigue life of the ship's structure. The material samples will enable experimental data to be collected, which will further provide technical authorities with a greater understanding of fatigue behaviour. The end result is that better, more informed decisions can be made by reducing uncertainties, which, ultimately, enables greater confidence in the safe operation of aging vessels.

Acknowledgment

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Works Cited

Callister, W., & Rethwisch, D. (2014). *Materials Science and Engineering.* Hoboken: John Wiley & Sons Inc.

Glen, I., Dinovitzer, A., Paterson, R., Luznik, L., & Bayley, C. (1999). *Fatigue-Resistant Detail Design Guide for Ship Structures.* Washington, D.C.: Ship Structure Committee.

Hageman, R., Drummen, I., Stambaugh, K., Dupau, T., Herel, N., Derbanne, Q., Kim, P. (2014). Structural Fatigue Loading Predictions and Comparisons with Test Data for a New Class of US Coast Guard Cutters.

Huang, J. (2021, December 20). Email: MEJ Article // Fatigue & JSS Hull Monitoring System.

Huang, J. (2021, September 15). Email: Ship Life Extension // Current Strategy.

Light Structures AS. (2019). *194-160.00-025 Functional Description for Hull Monitoring System.* Oslo.

Light Structures AS. (2022). *The technology behind our structural monitoring systems*. Retrieved from: https://www.lightstructures.com/structural-monitoring/

Seaspan Shipyards, @. (2021, October 20). *From our #VancouverShipyards modernization, to designing and building world-class vessels for the @CoastGuardCAN and the @RoyalCanNavy [tweet]*. Retrieved from Twitter: https://twitter.com/MoreThanShips

Sieve, M., Kihl, D., & Ayyub, B. (2000). *Fatigue Design Guidance for Surface Ships.* West Bethesda: Naval Surface Warfare Center.

Smith, M. (2017). HMCS Iroquois Structural Testing Program. *NATO ST PSDS Meeting.* Helsinki.

U.S Navy Office of Information. (2021, November 12). *Aircraft Carriers - CVN.* Retrieved from America's Navy: https://www.navy.mil/Resources/Fact-Files/Display-FactFiles/Article/2169795/aircraft-carriers-cvn/

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FEATURE ARTICLE

Propulsion Gearing — How close to "the edge" is 0.1 mm?

By Claude Tremblay and Connor Murdock

How often have we repeated the same manoeuvre over and over again with no issue, until one day something happens?

That must have been the feeling of the crew on board HMCS *Charlottetown* (FFH-339) in August 2018 as they applied full rudder while going at full speed. Such a manoeuvre is always exciting, as it creates a large centripetal force that heels the ship to an impressive angle that makes sailors walk like they've had too much to drink, and is within the ship's designed capability. But how close is it actually to the edge? Not to the edge of capsizing, but to "the edge" for some piece of machinery.

On that day, as the crew leaned into the turn, engineers below decks heard a loud knocking noise emanating from the port-side gearbox. They quickly determined that the noise frequency matched the gearings' rotational speed, but only when the CODOG (combined diesel or gas) propulsion system was in cross-connect mode. The ship was able to proceed safely in unitized drive mode using the gas turbines only, but it would take some days of investigation to determine exactly which edge had been crossed.

The fact that the ship was at that moment operating in Arctic waters in support of Operation Nanook complicated the engagement of shore specialists. However, once the frigate arrived alongside in Nuuk, Greenland for a scheduled fuelling stop, the engine monitoring data was sent to headquarters electronically, including some videos in which the noise was clearly heard. Formation Gearing Inspector Pierre Boucher (who has since retired) later joined *Charlottetown* in the city of Charlottetown, Prince Edward Island where the gears were thoroughly inspected without revealing any apparent defect. Later, with the ship back in its home port at Halifax, field service engineer Edwin Heijboer from Schelde Gears was brought in from the Netherlands. More visual inspections, more fingers on gear teeth, more mystery.

To check for misalignment, a shaft extension stub was machined by Fleet Maintenance Facility Cape Scott (FMFCS) and attached so that it extended out from the idler gear journal. An ingenious yet simple device was the addition of a radial marking on the face plate (Figure 1) that Mr Heijboer said would help determine the exact

Photo courtesy Schelde Gears

Figure 1. Gear shaft extension stub with radial orientation marking to help determine the source of the noise.

orientation of the shaft when the noise was heard. As the gears turned, the people present in the machinery space listened and watched carefully, noting the position of the mark as the noise repeated itself. Once the gears were stopped, the shaft was rotated to the noted orientation so that the inspection could concentrate on the gear-tooth meshing in that position.

It didn't take too long after that to discover the source of the problem. With the use of straight-edges as guides, a single tooth in the port cross-connect idler gear's aft helix was found to be deformed by approximately 0.1 mm. This was enough to cause it to mesh with the pinion tooth ahead of the rest of the teeth, concentrating the force and creating the knocking noise.

We will discuss how this defect was made possible, and how to prevent similar events in a moment, but let's first take a look at the challenges involved with replacing the damaged gear.

Changing Gears

This was only the second time since the *Halifax*-class frigates were built a quarter-century ago that a gear had to be replaced. The first instance was in 2016 with a damaged tooth on a 950-kg lower idler gear aboard HMCS *Montréal*

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(see MEJ 85). The gear we were dealing with on *Charlottetown* was 1.14 metres in diameter and weighed 1650 kg, which presented its own challenges. The damaged gear was eventually safely removed under the supervision of the FSR, and shipped by air to the manufacturing plant of Renk GmbH in Augsburg, Germany.

In a similar process used for *Montréal*'s gear, it was accurately scanned, and a new gear was ground as an exact copy of the original one (minus the defect) to ensure it would mesh with the worn condition of the other gears. The installation of the new gear on board *Charlottetown* had to wait for the ship to return from a docking work period. These work periods are too busy and too dirty to risk having a gearbox opened. Unfortunately, now more than a year after the original incident, the installation would have to be done during the pandemic, which involved a great deal of paperwork and care to get Mr Heijboer safely back to Halifax from Europe.

With only a five-day window to conduct the actual installation, a large number of preparations were conducted in advance. These included reopening the access route by removing the soft patches in the three decks above the forward engine room, as well as in the side of the solid-waste handling compartment so the new gear could be lowered into the space. Since the gearbox was being opened, the entire area in the forward engine room abaft the gearbox had to be professionally cleaned. Personnel present during the installation work were also required to remove any loose jewellery, and other items from their pockets, to ensure no foreign objects would end up in the opened gearbox.

Physically moving the new gear at any stage was a delicate process that presented real risk of damage. These gears are manufactured to extremely tight tolerances, and as we saw with the tiny defect in the single gear tooth, any damage — no matter how minor — would render the new gear unserviceable. The gear and journals were wrapped in a thick layer of foam prior to being lifted from the jetty, and as we see in Figure 2, the clearance between the wrapping and the edges of the soft-patch access was minimal. It was thanks to the high level of skill of the FMFCS riggers that the gear was lowered into the machinery space without incident.

Once in the engine room, the 1650-kg gear was flipped 90 degrees so that the journals were in the horizontal position needed for the installation. Before the gear could be fitted in the gearbox, however, it needed a little bit of paint. As shown at Figure 3, six teeth were painted with a product called Dykem Red layout fluid. When the gears are operated at sea, the friction between the rotating gear teeth will remove the paint at the contact points, and the removed paint pattern will determine the correctness of the meshing alignment under loaded conditions.

All other photos by Connor Murdock, courtesy of FMFCS Cape Scott

Figure 2. The new gear is lowered through the soft patch with just millimetres to spare.

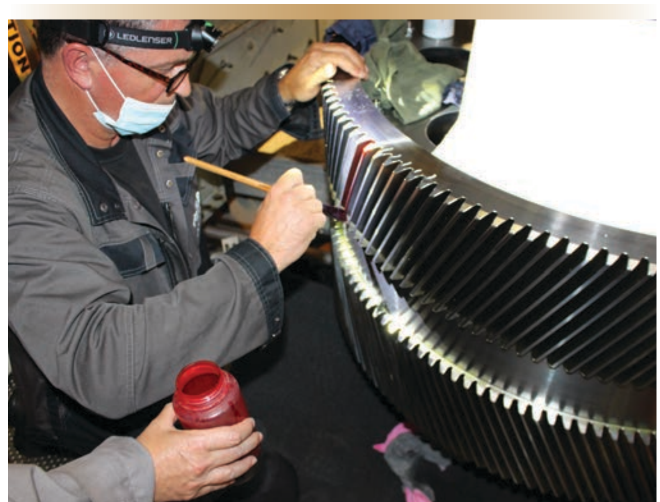

Figure 3. Painting sample teeth with Dykem Red for verifying correct gear meshing under at-sea operational load conditions.

Once the paint was dry, the process of meshing the new gear with the adjoining pinions was closely monitored by the Formation's new gearing inspectors, Patti Fraser and Stéphane Chouinard (Figure 4). The cross-connect gearing was mechanically disconnected from the rest of the gears to enable the main gearing and propulsion diesel pinions to rotate freely so that the new gear could be lowered and meshed correctly. Once fully meshed with both pinions, the gear was lowered to the point of contact with the bearings, and the two bearing housings were torqued down firmly (to specification).

To verify the specified *no-load* gear-tooth alignment, Prussian blue dye was applied to a number of gear teeth. Before it could dry, the gears were rotated using the turning gear until the blued teeth came into contact with their opposing numbers. Scotch tape was then introduced to the interfaces to capture the dye-transfer meshing contact pattern (Figure 5), which was then affixed to a plain sheet of paper to be kept as a record. It was a most effective demonstration of the value of a low-tech technique in a high-risk, high-tech environment. Once the proper alignment was confirmed, reassembly of the gearbox was completed to make ready for sea trials at a later date.

Figure 4. Formation gearing inspectors Patti Fraser and Stephane Chouinard observe the installation of the new gear.

Figure 5. The meshing contact pattern is transferred from the port pinion gear onto sticky tape, which will then be stuck down onto a sheet of paper to be kept as a record.

How did all this come about?

It is a matter of edges again. The *Halifax*-class frigates have two main gearboxes feeding two propulsion shafts, each with their own lubricating oil supply system. A single cruise diesel engine is fit between them, and is connected to the two main gearboxes through cross-connect gearing that does not have its own lube oil system. Rather, it taps into the shared port-side lube oil supply system. Since all of the cross-connect gearing's lube oil drains to the port-side main gearbox sump, no oil is supposed to accumulate at the bottom of the cross-connect gearbox. This implies that if the ship heels to starboard as it will during a hard-over turn to port, the port-side drain rises higher than the bottom of the cross-connect gearbox (Figure 6), meaning oil can then accumulate there. The greater the angle of heel, the more oil accumulates.

To prevent the gears from being wetted by any such accumulated oil, a shield is fitted under the diesel pinion — the centre gear in Figure 6 — but obviously has to stop short of the point where the adjoining gears mesh. In fact, it stops where the level of accumulated oil would reach at 20 degrees of heel (the design requirement for the *Halifax*-class ships was the ability to operate with a permanent 20-degree heel). If the oil flows over the edge of the shield, it will remain trapped inside. The gear will carry this accumulated oil, and thus create the action of a gear pump that forces the oil into the meshing with the port cross-connect idler. This creates a potential hydraulic lock situation between the gear teeth, and if any metal shavings or loose paint flakes are present in the oil, the oil pressure will keep this debris locked between the teeth during meshing. With *Charlottetown*, the force created was obviously large enough to deflect a single gear tooth by the small amount of 0.1 mm. That's how close "the edge" was in this case.

The control system data collected from the incident actually provided two clues that this was the situation. First, the oil level in the port gearbox sump indicated that 950 litres was missing, which would be the amount of oil accumulated in the cross-connect gearbox; and, second, there was a sudden increase in the lubricating oil temperature, the result of oil-churning from the pump effect.

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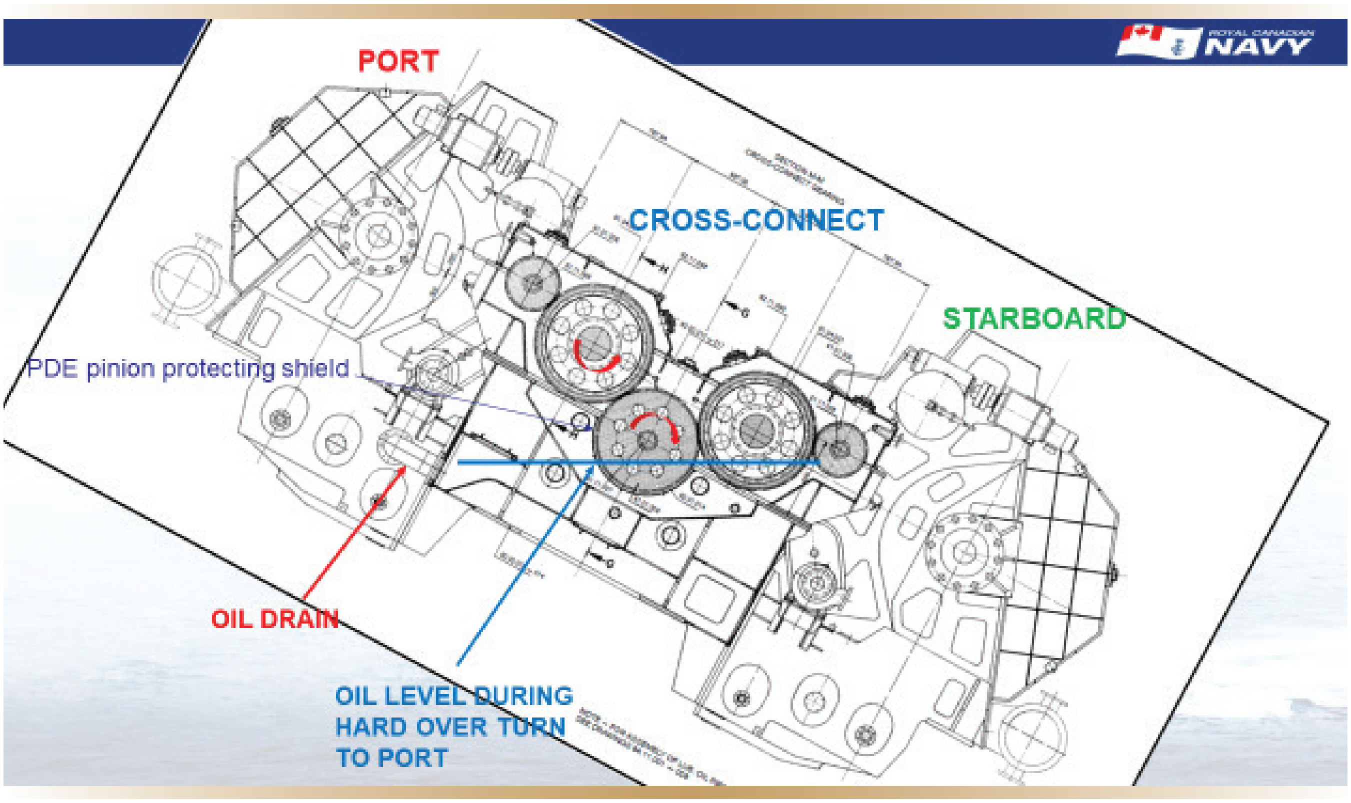

Figure 6. The cross-connect gear arrangement indicating the oil accumulating during high degree of heel to starboard.

There is an obvious, easy way to prevent such a costly repair situation from occurring in the future. When doing high-speed, hard-over turns, simply disengage the cross-connect gearing. It is unnecessary at high speed, and if the cross-connect gears are not turning, nothing bad can happen to them. Since the two shafts are designed to develop full power independently on the gas-turbine engines alone, the ship will still be able to safely demonstrate its amazing capabilities at high speed.

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Connor Murdock is a Mechanical Engineering student at Dalhousie University who worked at FMF Cape Scott Engineering through the cooperative education program.

Photo by Brian McCullough

FEATURE ARTICLE

A Proposal to Modify the Low-Pressure Air System Cooling Arrangement aboard *Halifax*-class Frigates*

By MS Nathanial R. Frid
(Technical Advisor: CPO1 E.G. Burns, Fleet Maintenance Facility Cape Scott)

[*Adapted from an October 2021 Marine Systems Engineering Division Mar Tech Mechanic RQ-P2 course student Technical Service Paper.]

A number of *Halifax*-class frigates have experienced seawater flooding of their low-pressure air (LPA) system. The ingress was a result of the after air cooler on the LPA compressor failing, and the pressure of the seawater service (SWS) system used for cooling being higher than that of the LPA system. Due to the corrosive nature of sea water, the LPA systems had to be flushed, and downstream components refurbished at significant financial cost. In some cases, the flush and other work took more than six months to complete, during which time the ship was unable to sail and fulfill mission requirements.

Two possible solutions for modifying this arrangement were investigated for course study purposes. The preferred one (Option A) uses an arrangement involving the fresh-water chilled-water system main, while the other (Option B) employs the auxiliary seawater circulation (ASWC) system to cool the LPA system.

Current Configuration

LPA coolers use sea water from the SWS system operating at 12 bar, a pressure greater than that of the LPA system which operates at 8 bar. Sea water from the SWS main proceeds past the normally open primary isolation valve to a secondary isolation valve, which is also normally open to the pressure-regulating valve that has an isolation valve on either side. Pressure is reduced to 2 bar through the pressure-reducing valve, which is fitted with a bypass in the event of failure.

Sea water passes through the after air cooler, which is protected by two zinc anodes, to cool the compressed air. When the sea water exits the after cooler, it goes through the compressor oil cooler — protected by three zinc anodes — and then through a diaphragm isolation valve before discharging to the ASWC system. In the after engine room (AER), the LPA cooler discharge connects to the discharge side of the port controllable reversible pitch propeller (CRPP) cooler, and in the forward engine room (FER) it connects to the discharge side of the port engine space cooler.

Figure 1. Screw-down non-return valve aboard a *Halifax*-class frigate.

Atmospheric pressure air drawn in from the citadel on three deck is compressed to 8 bar by the rotary vane compressor, then discharged to the after air cooler. As this occurs, the air passes through a paper water separator where bulk water droplets are removed and discharged to the inside machinery space (IMS) drain. The air is discharged to the dryer through a screw-down non-return valve (Figure 1), whose purpose is to prevent LP air from returning back through the compressor. In order for sea water to get into the LPA system, the sea water has to go through this valve at a greater pressure than the LPA system pressure. Possibilities of how this situation might have occurred are as follows:

a. The seawater discharge from the after cooler shares an overboard discharge with the port CRPP cooler in the AER, and with the port engine space cooler in the FER. If either of the overboard discharges were isolated, the

(Continues next page...)

after air cooler tubes could rupture, allowing sea water to enter the compressor air discharge ahead of the screw-down non-return valve, building pressure beyond 8 bar. With the LPA system pressure unable to keep the valve closed, sea water would discharge into the system.

b. If the seawater pressure-reducing valve failed to reduce the seawater pressure to 2 bar, the result would be the same as in paragraph a.

c. Constant changes in the SWS system pressure require manual adjustments to the pressure regulator bypass valve. If the seawater pressure regulator bypass valve were opened, and not manually set to 2 bar, the result would again be the same as in paragraph a.

The Problem and Criteria for Solution

The problem with using the current SWS system is that the supply pressure coming from the fire main is greater than the LPA system pressure that keeps the non-return valve closed when the compressor is not running. Sea water causes corrosion in the after cooler, which degrades the tubes that cool the compressed air. If the seawater pressure regulator fails, which it commonly does, or the return is shut, the weakened tubes can burst and pass sea water through the screw-down non-return valve into the LPA system.

In order to prevent seawater migration into the LPA system, and thereby eliminate the high cost of flushing the LPA system and refurbishing any corrosion damage downstream, the following considerations are offered:

- The cooling medium supply pressure should be lower than the LPA system pressure to guard against accidental ingress;
- The cooling medium could be *prevented* from entering the LPA system (i.e. by using a separate closed coolant supply system);
- The cooling medium should be non-corrosive (i.e. using fresh water rather than salt water).

Option A – Changing to a Chilled-Water Cooling Medium

Option A investigated utilizing the chilled-water main. This system uses fresh water mixed with glycol and a rust inhibitor, and operates at a maximum pressure of 4 bar. Since the supply and return piping (Figure 2) runs over both LPA compressors, the chilled-water main could be connected to the inlet ahead of the second isolation valve (Figure 3) on the supply side, and to the oil cooler outlet isolation valve for the return (Figure 4). The current SWS supply line from the fire main would have to be removed and capped. The total cost of installation was estimated to be $28,800.

Figure 2. Chilled water supply and return.

Figure 3. Flex line to LPA compressor cooling.

Figure 4. Flex line to the chilled-water return main.

Option B – Changing to the ASWC System for Cooling

Option B investigated using the ASWC system, which would only require installation of an isolation valve and a hard copper line to the inlet of the secondary isolation valve. The SWS system supply line would still need to be removed and capped. However, the point where the new isolation valve would be placed differs for the two engine rooms: In the AER, it would be by the inlet of No. 2 chiller (Figure 5); and in the FER, it would be ahead of the inlet isolation valve for the port space cooler (Figure 6). No changes would be required for either of the returns from the LPA compressor oil coolers. Total cost of parts and labour would be the same as for Option A.

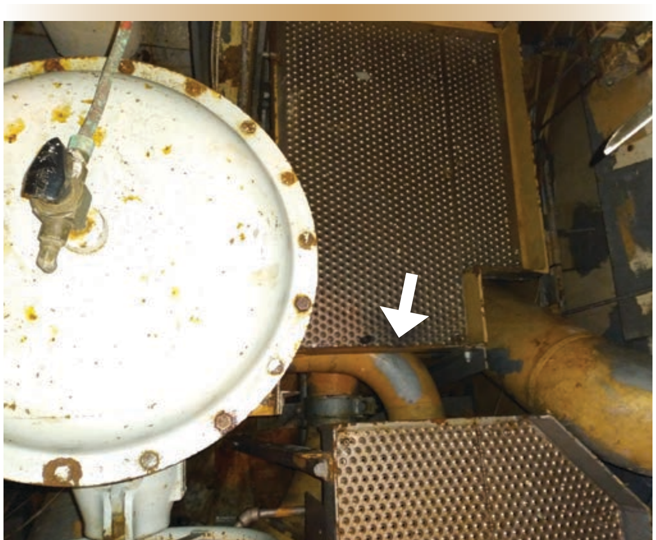


Figure 5. The auxiliary seawater circulation (ASWC) system supply in the after engine room.

Figure 6. ASWC supply in the forward engine room.

Option Analysis
Option A (Preferred)

The *Halifax*-class frigates were initially fitted with four 85-ton chillers, which did not generate enough chilled-water capacity to meet the full cooling demand including the LPA coolers, hence the use of the SWS system for this purpose. However, the frigates today are fitted with four 114-ton chillers that are more than capable of servicing the LPA system.

There are a number of advantages to utilizing the chilled-water system. Having fresh water mixed with glycol and a rust inhibitor as the cooling medium, rather than sea water, will prevent corrosion to the LPA coolers, thereby increasing their life expectancy, and eliminating millions of dollars in unnecessary labour and parts costs to flush the system and refurbish corrosion-damaged components over the lifespan of the frigates. The RCN can also still use the spare coolers that are currently in the stores system.

Critically, the freshwater medium will not harm downstream components should it ever discharge into the LPA system. Due to the steady operating pressure of the chilled-water system being just 4 bar, the medium cannot normally force its way past the screw-down non-return valve that is kept shut by the higher 8-bar pressure of the LPA system, even when the compressor is not in use. The environmental impact if the oil cooler fails is also greatly reduced, since the chilled-water system is a closed system.

One small disadvantage of using the chilled-water main is that the seals in the coolers might not be compatible with glycol, and would therefore need to be replaced. This is heavily outweighed by the potential savings, and the reduced loss of ship availability.

Option B

The advantage of utilizing the ASWC is that only one portion of the LPA cooling system would need to be modified – the inlet. All other parts of the current arrangement, including the seawater discharge from the LPA compressor, would remain the same. Since the ASWC system operates at only 1.3 bar, the pressure-reducing valve could be fully bypassed without affecting the cooling to the LPA compressor. And because the system operates at a much lower pressure, sea water cannot push past the screw-down non-return valve to enter the LPA system if the after cooler fails, or if the seawater discharge of the compressor becomes plugged or isolated.

(Continues next page...)

There are several disadvantages, however. The cooling medium is still sea water, which will cause corrosion if it somehow gets into the LPA system, and the ASWC system pressure can experience sudden drops when valves along its route are opened.

Summary and Recommendations

RCN ships have had a few instances of sea water migrating into the LPA system through failure of the after air cooler compressor, thereby allowing the higher pressure of the cooling seawater service to overpower the non-return valve normally kept shut by the lower pressure inside the LPA system. This has cost the RCN millions of dollars in flushes and repairs.

In this present study conducted for course purposes, the preferred solution (Option A) recommends that the chilled-water system, which uses fresh water infused with glycol and a rust inhibitor, be used in place of the SWS system to prevent degression of both the oil cooler and the after air cooler. Since the medium is at a lower pressure than the LPA system, the likelihood of it migrating into the LPA system is minimal, but should it do so, there would be no salt in the system to corrode components that interface with other vital systems, and a system flush would be much less labour-intensive as one involving sea water. There would be significantly less impact on ship mission readiness.

It is therefore recommended that the following actions be taken:

1. Raise an Unsatisfactory Condition Report (UCR) concerning the SWS supply pressure being higher than the LPA system pressure;

2. Request that Fleet Maintenance Facility Cape Scott (FMFCS) Engineering design and trial a new configuration for chilled water use; and

3. Create a permanent Engineering Change (EC) for all *Halifax*-class ships. [The author has since submitted a temporary EC for evaluation regarding proposed changes to the LPA cooling arrangement in the forward engine room. It is currently being reviewed. – Editor]

Master Sailor Nathanial R. Frid is a Marine Engineering Technician, and Supplementary Maintenance Team supervisor with Fleet Maintenance Facility Cape Scott in Halifax, NS.

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.

Photo by Brian McCullough

Title of Interest

"Mysterious Visitors" — A Play and Film Celebrating the Atlantic Charter

Written by Agnes Walsh

(Courtesy Barry Davenport, The Crow's Nest *Scuttlebutt*)

Many readers will be aware of the meeting between U.S. President Franklin D. Roosevelt and British Prime Minister Winston Churchill aboard the USS *Augusta* in Placentia Bay, off Ship Harbour, NL in August 1941. While it would be another four months before the United States entered the Second World War on the provocation of the Dec. 7, 1941 Japanese attack on Pearl Harbor, the summit produced the Atlantic Charter, a joint declaration of solidarity describing the principles on which a safe and secure international order should be based following the defeat of the Axis powers. The Atlantic Charter led to the creation of the United Nations in 1945, and sowed the seeds for the formation of NATO in 1949.

Courtesy: Admiralty Official Collection

U.S. President Franklin Roosevelt and British Prime Minister Winston Churchill on the quarterdeck of HMS *Prince of Wales* during the Atlantic Conference, August 10, 1941.

To commemorate the 75th anniversary of the Atlantic Charter in 2016, Peter Russell and other members of the newly formed Atlantic Charter Foundation (https://atlanticcharter.ca/), along with support from a number of affiliated organizations, commissioned Placentia, NL playwright Agnes Walsh to write and direct a play called "Mysterious Visitors." The play featured local actors, and made its debut at the Placentia Bay Cultural Arts Centre that August with the Hon. John Crosbie in attendance.

On Aug. 14, 2021, for the 80th anniversary, Russell debuted a film based on "Mysterious Visitors," co-directed by Agnes Marie Walsh and Nancy Kee. The film features a cast of Newfoundland actors portraying a Ship Harbour family trying to figure out what is happening when 18 British and American warships suddenly arrive offshore. Toronto actor Julian Mulock performed the role of H.V. Morton, the British travel writer summoned by Churchill to record the historic event. The film is now accessible on YouTube (https://www.youtube.com/watch?v=G1ogI145ANY)

In a fascinating follow-up Zoom event on Dec. 7, 2021 (Pearl Harbor Day), Russell presented "A Tale of Two Charters," in which he compared the Atlantic Charter that Churchill and Roosevelt constructed in 1941, with the New Atlantic Charter drawn up by present day British PM Boris Johnson and US President Joe Biden during the June 2021 G7 Summit in Cornwall, U.K. At the Zoom event, Robert Baines, President of the NATO Association of Canada, explained the continuing relevance of both Charters to the defence of democracy in today's world.

"Mysterious Visitors" is intended to be distributed as an educational tool to introduce students to the historical importance of the Atlantic Charter, while at the same time providing an entertaining glimpse into the social life of Ship Harbour residents in 1941.

The film production was made at a cost of $31,000 and to date funds have been raised totalling $19,000. Donations may still be made through the International Churchill Society (Canada) website (http://www.winstonchurchillcanada.ca/). In order to attract more sponsors, donations of $30 will be rewarded with a commemorative DVD of the play, while donors of $50 or more will also receive a frameable certificate signed by Peter Russell, along with a frameable copy of the Atlantic Charter.

NAVAL TECHNICAL OFFICER AWARDS

2020 L3 MAPPS
Saunders Memorial Award

SLt Victor Dule

Top student, Marine Systems Engineering Applications Course

Presented remotely by Wendy Allerton
Director, Business Development
L3Harris Maritime International Sector
Integrated Mission Systems

2020 Lockheed Martin Canada Award

Lt(N) Courtney Williams

Top Combat Systems Engineering Phase VI candidate

Presented remotely by Simon Hughes
Senior Business Development Manager
Lockheed Martin Canada

Déja vu!

A second look at stories from our archives.

Engineering Incident: No. 1 Diesel Failure
(From MEJ 25 – October 1991)

The events: A DDE 257-class ship was just finishing a short work period. A considerable amount of upperdeck chipping and painting work remained to be done, as did some minor engineering jobs. During the forenoon watch No. 1 diesel alternator was started for the first time after a complete overhaul (6400-hour routine). The watchkeeper was paying particular attention to his job as this was the first run-up. It was to be put on load for trials prior to acceptance. All temperatures and pressures were observed to be normal. After about an hour the lights dimmed and the diesel slowed down. The engine began to smoke and, before it could be shut down, seized solid. The elapsed time from the engine's slowing down to its seizing was about one minute. The CERA and Engineer were notified and an investigation was started.

Machinery damage: Upon opening up the engine it was discovered that another complete overhaul would be required. The failure resulted from the ingestion of foreign material, later determined to be non-skid (that was being chipped from the fo'c'sle) which had been sucked into the engine through the intake, ground up by the blower, and deposited in the cylinders. Within one hour, 6400 hours had been "logged" on a refurbished engine.

Lesson learned: Always inspect intakes and the area around them before starting machinery.

NEWS BRIEFS

2022 RCN Naval Architecture Conference is in the books!

By LCdr Mark Bartek

This year's roll-out of the annual RCN Naval Architecture Conference, held Feb. 22-24, was an outstanding success. Despite, or perhaps because of the virtual nature, there was a great turnout, with more than one hundred people in attendance, representing the Royal Canadian Navy's technical facilities on both coasts, academia, research, and industry. We had a fantastic mix of topics including: Current RCN fleet issues, new ship capability and delivery projects, Defence Research and Development Canada research, digital solutions from Babcock, lessons learned from Class Societies, decarbonization in the maritime industry, and Royal Navy emergency response.

As the *Halifax*-class frigates approach the end of design life, the Nav Arch community is addressing two main areas of concern. The first pertains to stability and the management of weight growth until the Canadian Surface Combatant (CSC) is delivered. The Directorate of Naval Platform Systems (DNPS 2-3) is actively engaged in evaluating the current status of the class, and identifying potential solutions that will allow the ships to meet requirements for intact and damaged stability, while limiting operational restrictions. The aim is to take the margin and stability lessons learned from the *Halifax* class, and apply them to the design work being undertaken for CSC.

The second area of concern is the 5200-tonne displacement limit outlined in the Halifax Class Design Disclosure Document, and corrosion. The displacement limit is related to the stability challenges, and a separate task (with DNPS 2-2) to re-assess the structure is underway to determine whether this can be exceeded, or if operational restrictions will be necessary. The issues with corrosion are ongoing and not unique to the *Halifax* class, and are being discussed in the Corrosion Material State Working Group.

For next year's conference we are hoping that an in-person event will be possible, in conjunction with video teleconferencing, to allow for the widest possible engagement by the Nav Arch community. We are also looking to include presentations from PMO CSC, and the submarine replacement project, so as to involve these growing areas of interest. If you have any questions about the Nav Arch Conference, or are interested in pursuing this engineering specialization, please contact the undersigned.

Most of the presentations from the 2022 Nav Arch Conference are available on the Naval Architecture Conference Sharepoint site (https://collaboration-materiel.forces.mil.ca/sites/MEPM/DNPS/DNPS2/RCNNAC/RCN%20NAC%202022/Forms/AllItems.aspx), available through the DND Intranet. If you are interested in seeing the full list of presentations, or obtaining copies of the PowerPoint slides, please contact LCdr Mark Bartek, mark.bartek@forces.gc.ca.

NEWS BRIEFS

Contract awarded for NEXT-ECS to Dartmouth's LeeWay Marine

(MatFlash)

On December 1st, Defence Minister Anita Anand announced that LeeWay Marine of Dartmouth, Nova Scotia was awarded the Naval Experimentation and Testing – Engineering Charter Service (NEXT-ECS) contract. The NEXT-ECS contract provides a variety of at-sea platforms to facilitate innovation trials in support of the Naval Technical Innovation Program, as well as partner innovation programs within the Royal Canadian Navy and Defence Research and Development Canada. The $8.9 million contract has an initial duration of three years with options for up to three additional years.

Director Naval Platform Systems 5 (DNPS 5) within Director General Maritime Equipment Program Management (DGMEPM) is taking the lead on management of this contract. If you have a potential innovation that would benefit from this test platform, please contact LCdr John Faurbo or email the DNPS 5 positional mailbox.

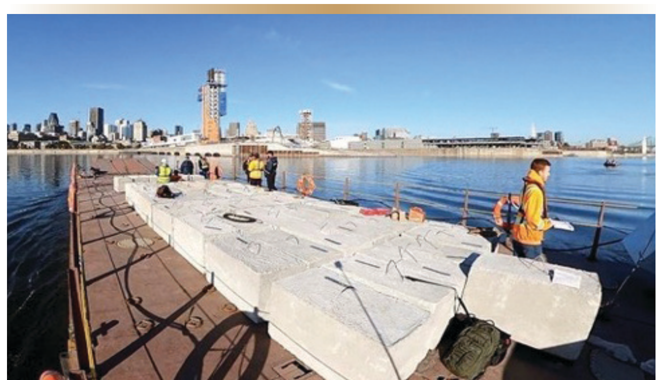
Joint Support Ship Project Management Office attends successful in-water Factory Acceptance Test for Sea-to-Shore Connector system

(MatFlash)

The Project Management Office for the Joint Support Ship participated in a successful in-water Factory Acceptance Test for the first of four Sea-to-Shore Connector systems. Constructed by Navamar in the Port of Montreal, these systems will give the future *Protecteur* class an important amphibious capability.

The trial demonstrated compliance with key requirements such as top speed under load, turning radius, and assembly timings in a real-world environment.

The Sea-to-Shore Connectors will be able to carry 50 tonnes of cargo at a speed of five knots in sheltered harbours where the ship cannot go alongside. Its beaching capabilities, with roll-on/roll-off ramp will provide the Royal Canadian Navy (RCN) a high degree of flexibility in supporting humanitarian assistance, disaster relief and/or joint operations ashore.



Courtesy MatFlash

The modular pontoon barges are assembled in the water, with the flexibility to load anything from vehicles to sea containers of supplies, and then shuttle these to shore.

Once the system components have been blasted and painted according to RCN ship colour schemes, the system will be delivered to Esquimalt, followed by Initial Cadre Training, and Acceptance Trials this spring.

NEWS BRIEFS

New large tug boats honour Canada's maritime history

(RCN Navy News / December 9, 2021)

The Royal Canadian Navy (RCN) announced that the names of its new fleet of large tug boats will pay homage to Canada's extensive maritime history.

"I am pleased today to announce the names of the Royal Canadian Navy's new fleet of Naval Large Tugs. *Haro*, *Barkerville*, *Canso* and *Stella Maris* provide important linkages to Canada's rich maritime history and their role is tied to our future," said Vice-Admiral (VAdm) Craig Baines, Commander of the Royal Canadian Navy.

The four Naval Large Tugs (NLT) are being built by Ocean Industries Inc. of Isle-aux-Coudres, Quebec, under the National Shipbuilding Strategy, and are named after tugs that perished in the performance of their duties or locations on the East and West coasts that are linked to RCN maritime heritage.

NLT *Haro* is named after the Haro Strait, which connects the Straits of Georgia and Juan de Fuca in British Columbia, and is frequently transited by RCN vessels proceeding north from Esquimalt, the home of our Pacific Fleet.

NLT *Barkerville* takes its name from the Second World War-era *Ville*-class tug of the same name, which sank on December 17, 1945 at the entrance of Bedwell Harbour, B.C., while towing His Majesty's Canadian Ship (HMCS) *Hespeler* to its mooring. The *Ville*-class tug was named after the town of Barkerville, located in Central British Columbia.

NLT *Canso* is named after the Canso Strait, which separates Nova Scotia from Cape Breton Island. The region figures prominently in Canada's formative history, and in the RCN's past with HMCS *Canso*, a *Bangor*-class minesweeper that served in the Pacific and Atlantic during the Second World War, and was on hand for D-Day.

NLT *Stella Maris* is named in recognition of the valiant actions of the crew of the tug of the same name that came to the assistance of the SS *Mont Blanc*, a French munitions ship laden with explosives, on December 6, 1917 in Halifax Harbour. The *Mont Blanc* had collided with the Norwegian SS *Imo*, starting a fire on the French ship that forced the

(Continues next page...)

NEWS BRIEFS

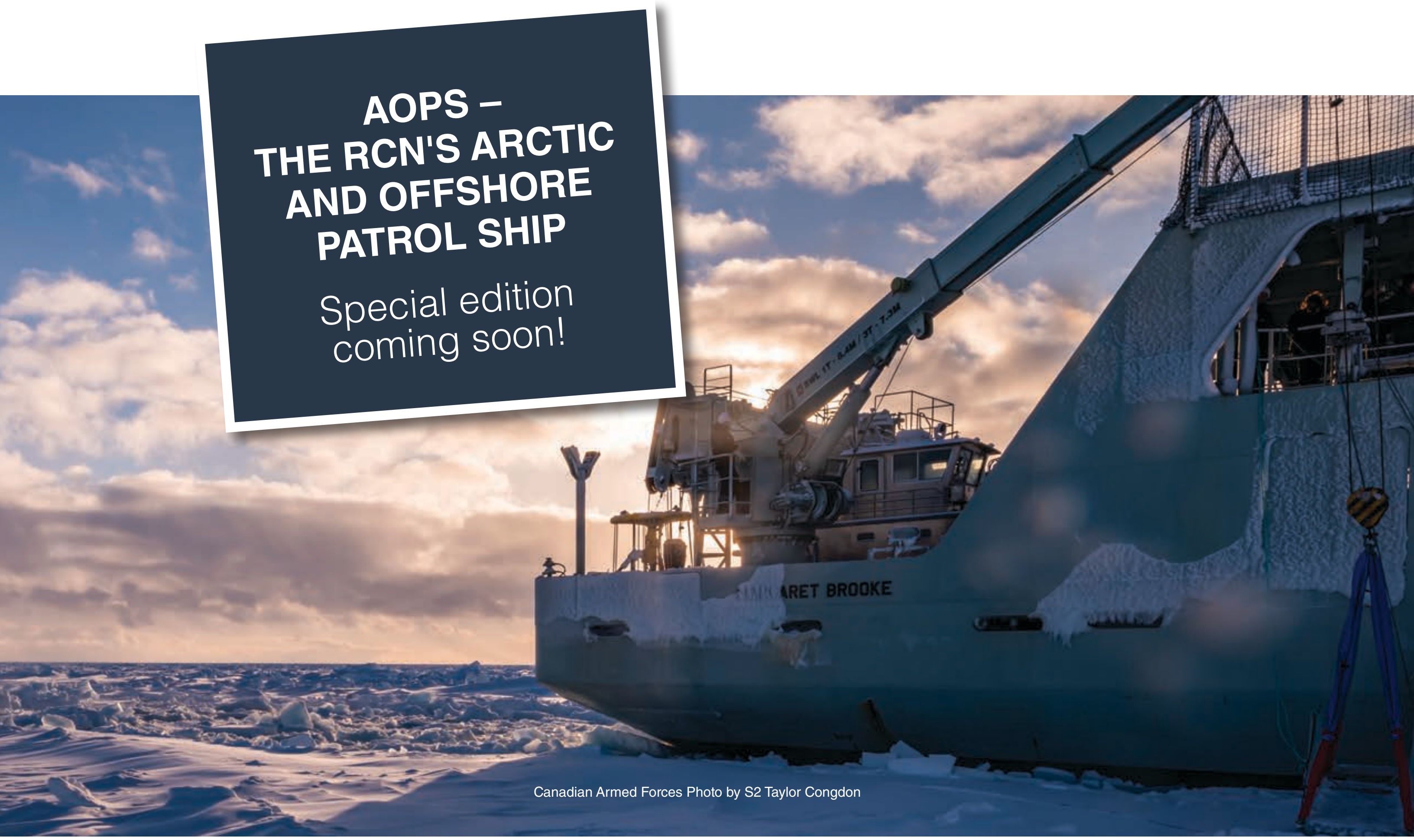
crew to evacuate. *Stella Maris* was the first to arrive at the burning munitions ship, spraying the flames with its fire hose. As the fire was too intense to stop with a single fire hose, the *Stella Maris's* crew began to prepare a towline to pull the French vessel away from Pier 6 to prevent the fire from spreading ashore. The crew were in the process of retrieving a 10-inch hawser from the hold to assist a party of volunteers from HMCS *Niobe's* steam pinnace in securing a line to *Mont Blanc*. Before this could be done, the now-infamous Halifax Explosion occurred.

Stella Maris was severely damaged and thrown up on the beach near Pier 6, with the bow ashore and the shattered stern submerged. Nineteen of the crew were killed, including Captain Horatio Harris Brannen. Miraculously, five managed to survive.

Today, navy tugs continue to be an important component of the RCN fleet, performing a wide variety of tasks including harbour berthing, coastal towing, harbour firefighting and other naval fleet support duties. The new tugs will replace the current *Glen*-class fleet, which were acquired in the mid-1970s and are reaching the end of their service life.

Serving on both coasts, this new, more powerful fleet of tugs will support the RCN's current and future fleets, including the six Arctic and Offshore Patrol Ships, two Joint Support Ships and 15 Canadian Surface Combatants.

The steel-cutting for the first tug, *Haro*, began in September 2020, with formal construction following in November 2020. The first two tugs are expected to be launched in June 2022 and July 2022, respectively, with first deliveries expected by the fall of 2022. (See also MEJ 97)



Canadian Armed Forces Photo by S2 Taylor Congdon

PRESERVING CANADA'S NAVAL TECHNICAL HERITAGE

CNTHA

NEWS (SPRING 2022)

Canadian Naval Technical History Association

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Est. 1997

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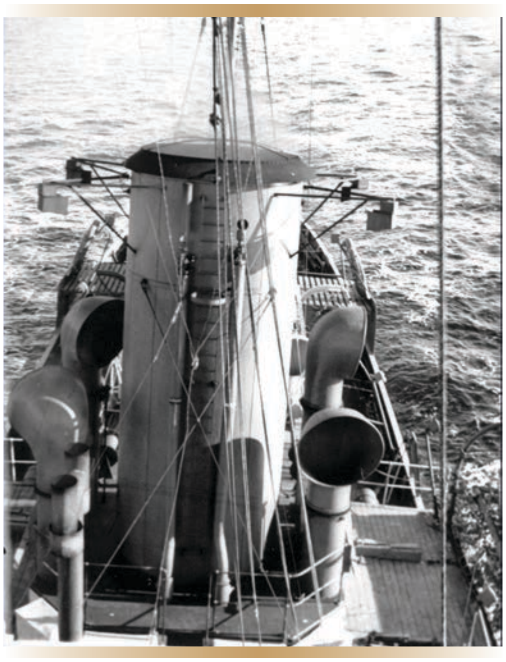
Innovation – The light bulb went on!

By Cdr (Ret'd) Pat Barnhouse

The concept of diffused lighting for concealing a ship at night, especially from an attacking submarine, was proposed early in the Second World War by Professor Edmund Godfrey Burr of McGill University, Montreal. At night, it was possible for a ship to be seen through a submarine's periscope as a dark object against the lighter background of the night sky, which is rarely pitch black. The suggested approach was to illuminate the hull and superstructure of the ship using photocells to match the level of the background sky.

Original experiments began in January 1941 with the corvettes HMCS *Cobalt* and HMCS *Chambly*, and by August of that year, a prototype system with automatic control was fitted to HMCS *Kamloops*. Various trials and demonstrations were carried out, including one in the Clyde for the benefit of the British Admiralty, reportedly using HMCS *Trillium*, although I can find no corroborating record of this ship being so fitted. One result of this latter trial was that the RN proceeded to further develop and fit a system in a converted merchantman, HMS *Largs*. Results from this installation and subsequent trials were conveyed back to Canada, resulting in further redesign of the automatic controls for the system by National Research Council (NRC) and naval personnel.

Production versions of the diffused lighting apparatus were contracted for and manufactured by General Electric of Schenectady, NY, using data supplied by Canadian engineers and scientists — an interesting comment in itself on the state of industrial development in Canada at the time. Systems were fitted aboard HMC ships *Edmundston* and *Rimouski* in the latter part of 1943 for further trials. It is reported that Professor Burr went to sea in *Edmundston* for some of the trials, assisted by Electrical LCdr Reside McCullum, RCNVR (who had been involved in the redesign of the lighting control system), and Acting Electrical LCdr T.R. Durley, RCNVR. Despite being considered operational, trials of the system continued through late 1944 and early 1945 off the East Coast of Canada, near Bermuda, and in UK waters.



RCN photo

HMCS *Kamloops* with diffused lighting camouflage fittings on struts around the funnel, September 1941.

One trial report tells of an Allied submarine being unable to visually detect the illuminated HMCS *Edmundston*, even though it got to within 700 yards of the accompanying control corvette which was easily seen. When the submarine commander asked for "lights off," *Edmundston* leapt into view only 300 yards away. When the commander requested "lights on" again, the ship disappeared, and could not be detected again despite knowing exactly where to look.

An operational UK report of the HMS *Largs* trials nicely summarized the advantages and disadvantages of diffused lighting. In favour was its effectiveness at night in matching any ship paint scheme to the background, thus allowing optimization of camouflage paint schemes for reduced daytime visibility. Against its use was the growing proliferation of radar at sea, its less-than-optimal performance in certain nighttime conditions such as moon light, and the complexity and fragile nature of the outrigger lighting fixtures.

(Continues next page)

Information for this summary was found in a number of sources, some of which bedeviled me by the contradiction in dates of events. Three contemporary government reports that are considered to be the most reliable in this respect are:

- HMS *Vernon* Trial Report No. D.L. 126, Diffused Lighting Trials HMS *Largs* (undated).
- Research Laboratories of the General Electric Co. Ltd. (UK), Report No. 7924, Diffused Lighting, March 16, 1942.
- Report on Revised Control Gear for Diffused Lighting Developed by National Research Council, December 15, 1944

Further information was found in the following books:

- Eggleston, W., Scientists at War, Oxford University Press, Toronto (1950).
- Fetherstonhaugh, R.C., McGill University at War, Gazette Publishing Co. Ltd., Montreal (1947).
- Lindsey, G.R. (Ed.), No Day Long Enough – Canadian Science in World War II, Canadian Institute of Strategic Studies, Toronto (1998). ISBN 0-919768-65-9.
- Lynch, T.G., Canada's Flowers – History of the Corvettes of Canada 1939-1945, Nimbus Publishing Ltd., Halifax (1981). ISBN 0-9208552-15-7.

A more detailed Wikipedia account of this fascinating wartime technology may be found at:

https://en.wikipedia.org/wiki/Diffused_lighting_camouflage

British Admiralty photo, National Archives ADM/116/5026

Bulwark of HMS *Largs* showing four diffused-lighting camouflage fittings, two lifted inboard, two deployed, for trials in the Clyde Approaches, 1942.

The Canadian Naval Technical History Association congratulates the *Maritime Engineering Journal* (MEJ) on the occasion of the magazine's 40th anniversary of continuous publication, and the release of MEJ 100.

The CNTHA has enjoyed a wonderful working relationship with the *Journal*, beginning with MEJ 44 in the summer of 1998. We gratefully acknowledge the enormous benefit this has made in the pursuance of CNTHA's goal of documenting the technical history of the Royal Canadian Navy, in support of the DND Directorate of History and Heritage.

The *Journal* plays a vital role in this regard. What is in the *Journal* today becomes the history of tomorrow, and this intrepid branch technical forum has a proven record of showcasing the excellent efforts and achievements of the RCN's technical support community.

On behalf of the CNTHA, we wish the *Maritime Engineering Journal* continued success long into the future.

— Cdr (Ret'd) Pat Barnhouse, CNTHA Chairman, and
Cdr (Ret'd) Tony Thatcher, CNTHA Executive Director