National Defence Défense nationale

Maritime Engineering Journal

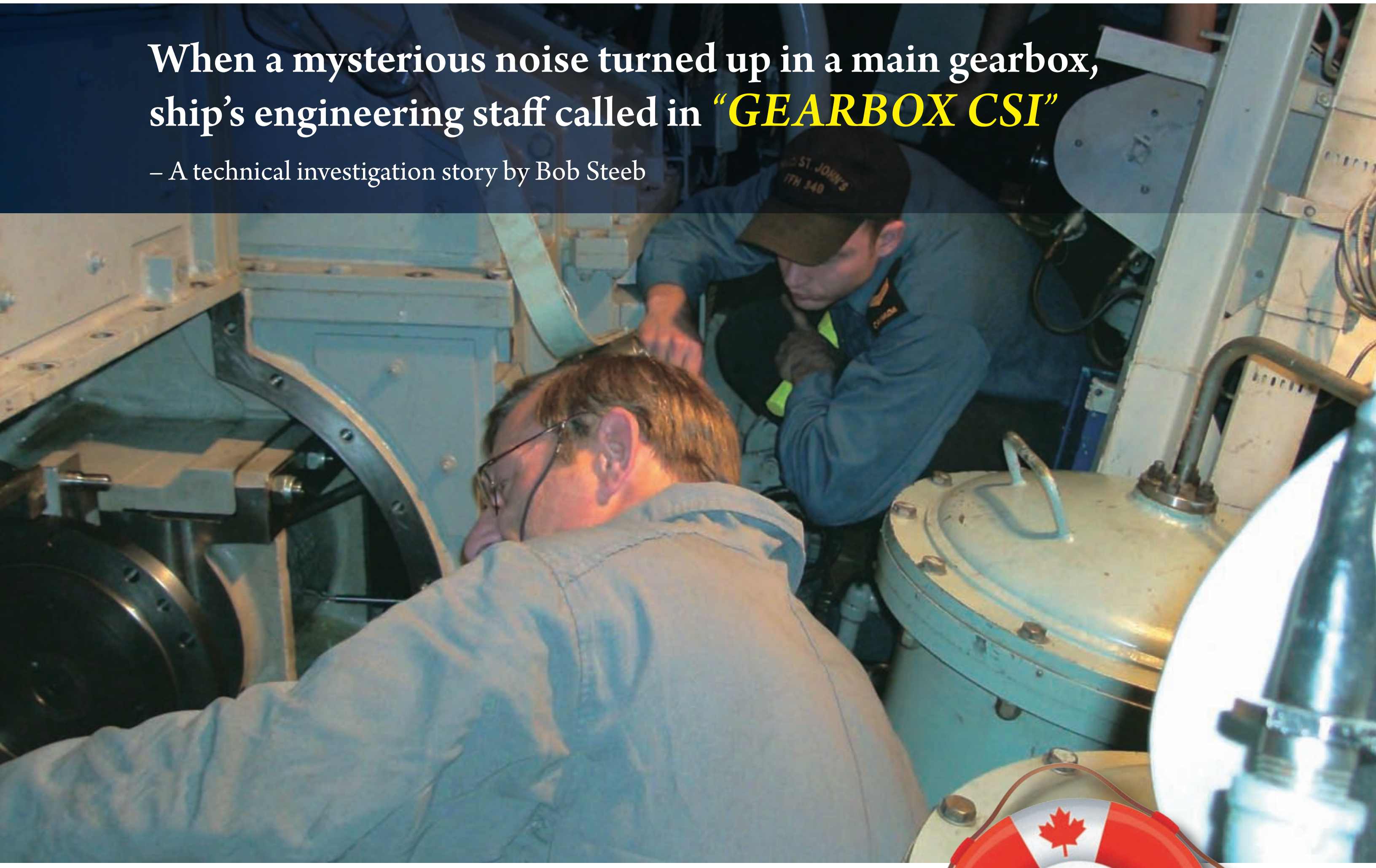
67
Since 1982

Canada's Naval Technical Forum

Spring 2011

When a mysterious noise turned up in a main gearbox, ship's engineering staff called in *"GEARBOX CSI"*

– A technical investigation story by Bob Steeb



Also in this Issue:

- Design Space Analysis
- Forum: An offer of assistance from "another" source of experience
- CNTHA News: The Way Ahead

Canada

2010 NTO AWARD WINNERS AND RUNNERS-UP

The NTO awards recognize the dedication, hard work and technical excellence of NTOs in obtaining their training milestones during the previous year. Regardless of who wins any particular award, it is a significant accomplishment even to be considered a candidate. The 2010 awards were presented at the Naval Technical Officers Mess Dinner on March 24, 2011 at the CFB Halifax Wardroom.

Photo by Cpl Ron Kinnie, Formation Imaging Services Halifax

Back Row: Lt(N) Jeffery Vanderploeg, Lt(N) Raphael Liakas, SLt Alexander Cross, SLt Victor Armes, SLt Troy Ingram, SLt Yves-Etienne Landry, SLt David Stewart

Front Row: Lt(N) Ashley Hunt, Lt(N) Matthew Webb, Lt(N) Meryl Sponder, SLt Aislinn Joiner, SLt Devin Kester, Lt(N) Anthony Carter

Missing: SLt Michael Machnee, Lt(N) Lisa Shields

– Awards photos on page 15 –

Director General
Maritime Equipment Program
Management

Commodore Patrick T. Finn
OMM, CD

Maritime Engineering Journal

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(Established 1982)
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Feature Article

2010 Naval Technical Officer Awards

News Briefs

CNTHA News

Senior Editor
Capt(N) Mike Wood
Chief of Staff MEPM

Project Manager
Lt(N) Chris Hircock

Production Editor/Enquiries
Brian McCullough
brightstar.communications@sympatico.ca
Tel. (613) 831-4932

Graphic Design and Production Services
d2k Marketing Communications
www.d2k.ca
Tel. (819) 771-5710

Our new look —

The *Journal* welcomes a new production team with this issue. After more than 25 years of managing both the editorial and production sides of the house, Brian McCullough has associated himself with the production firm of **d2k Marketing Communications** to continue delivering our branch periodical.

The company is no stranger to the *Journal*. D2K has been turning Brian's cover designs into printable files for years, and will now take the lead on our new contract for editing and production services. We couldn't be in better hands.

Sadly, we do say farewell to associate editor **Bridget Madill** who has worked behind the scenes on the Journal since 1985. When her husband Brian took over as our full time production editor, Bridget brought her considerable editorial, management and computer skills into play for us. We offer her our thanks for a job well done over so many years.

As the Journal moves forward we sincerely hope you enjoy our new, yet familiar look, and give your welcome to marketing communications general manager **Daniel Dagenais**, graphic designer **Patrick Mathieu** and the rest of the great team at d2k.

The Editor

The *Journal* is available on line at the website of the Canadian Naval Technical History Association – www.cntha.ca

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Commodore's Corner

By Commodore Patrick T. Finn, OMM, CD, Director General Maritime Equipment Program Management

Complex naval materiel program calls for increased focus from all of us

As this edition of the *Journal* is published, I find myself looking back at almost a year of being back in the Maritime Equipment Program Management division. It has already been quite a rollercoaster ride of activities, and has been a particularly positive experience thanks to all of the people across our naval materiel branch with whom I am privileged to work on a daily basis.

The naval materiel enterprise is very complex in that it requires us to simultaneously execute an overall $1-billion maritime equipment program for the in-service fleet, while ensuring the fleet is both materially ready for operations and safe. It is also very complex in that it is all too often focused on the in-year financial allocations. By my estimate the true measure of the capacity to execute this program is the number of experienced people we have available to undertake the work required to meet the demands. We are very fortunate to have a professional and dedicated group of people who are ready and willing to support the fleet, but there are limits to how much work we can undertake. We need to be very careful about how much churn we inject into the system.

Large-scale fleet renewal is upon us as we can see from some of the milestones recently achieved. On the submarine front the undocking of HMCS *Victoria* has now occurred and we are steadily on the path to getting her back into operations. With HMCS *Windsor* and HMCS *Chicoutimi* close on her heels, we will soon be supporting multiple submarines deployed on operations. The first *Halifax*-class mid-life refit is now well underway and, as I write, the second ship is about to enter dock on the West Coast. When combined with the large number of Major Crown Projects that are gaining momentum, these major vessel upgrades will demand increased focus from all of us who work on keeping the fleet technically ready.

One of the major initiatives that will help us focus as a branch is the updating of the Naval Materiel Management System (NaMMS) policy document. The more seasoned members of the branch will notice the change in name (and focus) to *Materiel* Management vice *Maintenance* Management, which will be explained in detail in the forthcoming communications plan following the official


Photo by Brian McCullough

Submarine refit work for HMCS *Windsor* (SSK-877) goes on under wraps at the Halifax naval dockyard in March.

"We are very fortunate to have a professional and dedicated group of people who are ready and willing to support the fleet..."

release of the updated NaMMS manual in the next few months. How will an update in policy impact on our ability to support the fleet? By better defining our authorities and accountabilities such that they can be exercised at the appropriate levels within the organization, some of the unnecessary work caused by uncertainty over authorities can be eliminated. The new NaMMS will be followed by an update to the Naval Engineering Manual, which will remain focused on the work that occurs in direct support of the ships at sea.

The fiscal year we have just started will likely see us continue riding the same rollercoaster of activity. And yet, I find myself buoyed in this undertaking by the people who serve in our branch and by the new capabilities we will see delivered in the months and years ahead.

FORUM

AUXILIARY FLEET ENGINEERS' INPUT INTO NAVAL TECHNICAL FAILURE INVESTIGATIONS AND PROBLEMS

I recently read with interest the article in the Fall 2009/ Winter 2010 *Maritime Engineering Journal* edition number 65 related to the *Halifax*-class MWM engine failures. The assembly of fleet technical authorities and OEM representatives into a working group is an excellent means of troubleshooting difficult fleet-wide problems, but there is another source of marine engineering experience and knowledge within DND that remains untapped but which may be beneficial in the problem-solving matrix, i.e. civilian auxiliary fleet engineers. This group of technical subject matter experts is not normally involved in the investigative process at the DGMEPM level, but perhaps could provide support if there was an opportunity to do so.

Auxiliary fleet engineers on both coasts are well qualified and have several decades of marine engineering experience in both government and commercial service. Many are interested in technical problems experienced by other agencies. This information is of interest to us because we may have experienced similar problems in the past, and from a professional marine engineer's perspective are interested in how the problems are solved by others; or perhaps lessons learned from other failure investigations can be useful in assisting us in solving any current or future problems experienced within the civilian auxiliary fleet.

With respect to the failure of the MWM bottom end rod caps, during my time with Dome Petroleum Ltd. the 17,000-horsepower Class 4 icebreaker *Kigoriak* experienced a failure of a connecting rod in one of her 8500-h.p. medium-speed Sulzer Z-series engines. The rod failure was caused by a crack of a root of the female stud thread which, over a few years, propagated through the rod to a point where there was insufficient material remaining to withstand the high cylinder loads. When the rod failed it was propelled through the block, resulting in a crankcase explosion and fire (thankfully no one was injured). The subsequent investigation revealed that a stress-crack was caused by uneven loading (torquing) of the rod studs because a very small sliver of material had accidently squeezed between the rod and cap sometime during a previous inspection. The damage was extensive and a new block and crankshaft were required. The block (30 tonnes) and crank (15 tonnes) were shipped from the Sulzer engine plant in Switzerland to the Dome Petroleum repair facility in the Beaufort Sea in late fall, fitted during the winter shutdown period, and the vessel was returned to full icebreaking service by spring – a truly remarkable feat.

Canadian Forces auxiliary vessels in Esquimalt Harbour.

The MWM timing gear issue is similar to one I encountered with an older model Caterpillar diesel engine. We found the gear failure to be caused by a faulty crankshaft vibration damper which was producing dangerous critical speed vibrations that permeated through the crankshaft, not only damaging the crankshaft main bearings, but also the timing gears.

Coking or carboning issues are also not new, especially in lightly loaded two-stroke engines. A change to a more dispersant/detergent-type heavy duty lube oil and appropriate additive alleviated some of this problem. The article also notes that the injection timing was retarded to lower the cylinder mean effective pressure to reduce the load on the rod caps, but higher exhaust temperatures and incomplete combustion will likely follow which could lead to accelerated cylinder carbon issues.

Continued on next page...

There are many qualified employees with marine engineering technical experience and knowledge within DND who are not directly involved in technical investigations, but there should be an avenue by which DGMEPM could take advantage of this "free" resource. We are seldom privy to, or aware of issues raised by our naval partners, and frankly many naval personnel are not cognizant of the civilian Transport Canada marine engineering training or certificates of competency which are recognized worldwide.

Subject to security requirements, one suggestion is for DGMEPM to perhaps explore a technical type of website forum where knowledge and experience could be exchanged among interested DND personnel. Perhaps publishing this letter in the *Maritime Engineering Journal* will promote a positive dialogue to explore this possibility with interested stakeholders at DGMEPM and the formations.

We are willing to help if we can, just ask.

Sincerely,

Ed Gerow
Engineering and Floating Plant Manager
Port Operations and Emergency Services Branch
Auxiliary Fleet, CFB Esquimalt

Edward.Gerow@forces.gc.ca

In the *Maritime Engineering Journal* No. 66 – Naval Centennial Issue, the article by Brian McCullough on museums celebrating the centennial of the Canadian Navy (*Museums Celebrate Canada's Navy Centennial!*), while interesting, seems to us very incomplete if the purpose was to present what Canadian naval museums have accomplished in connection with the Canadian Naval Centennial.

For the Centennial, the Naval Museum of Quebec created the only travelling exhibition depicting 100 years of naval history. The exhibition visited a number of Canadian provinces throughout the year. At our location in Quebec City, moreover, the museum opened a permanent exhibition entitled "Meanders: Memories of War on the St Lawrence", which was produced to mark the Centennial, and the quality of which compares favourably with that of the major national museums. We might add that the Naval Museum of Quebec was the official presenter of the Rendez-vous naval de Québec, an event which brought ships of NATO's permanent fleet to Quebec City.

If you could mention our accomplishments in the near future, we would be grateful. Our Museum could provide you with a number of articles of interest to your readers, addressing such subjects as the first GLC Mark III radars installed along the St Lawrence in 1943 to track U-boats entering Canadian waters.

More information on our Museum is available at www.navalmuseumofquebec.com

Thank you for your attention to our comments.

Yours sincerely,

André Kirouac
Director
Naval Museum of Québec
Naval Reserve Headquarters
National Defence
170, rue Dalhousie
Québec (Québec) G1K 8M7

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 editor. Contact information may be found on page 1. Letters are always welcome, but only signed correspondence will be considered for publication.

OBJECTIVES OF THE MARITIME ENGINEERING JOURNAL

- To promote professionalism among maritime engineers and technicians.
- To provide an open forum where topics of interest to the maritime engineering community can be presented and discussed, even if they might be controversial.
- To present practical maritime engineering articles.
- To present historical perspectives on current programs, situations and events.
- To provide announcements of programs concerning maritime engineering personnel.
- To provide personnel news not covered by official publications.

TECHNICAL INVESTIGATION

WHEN A MYSTERIOUS NOISE TURNED UP IN A MAIN REDUCTION GEARBOX ON BOARD HMCS *ST. JOHN'S*, SHIP'S STAFF CALLED IN GEARBOX CSI

By Bob Steeb, Technical photos courtesy the author

Photo by Brian McCullough

It was something of a technical whodunit.

While using turning gear to turn the starboard gearing and shaftline on board HMCS *St. John's* in March 2010, engineering staff heard a prominent "knocking" noise coming from the starboard gearbox. What was it? A problem with the bearings? The shaft? A gear? Was it a lubrication problem?

With so many interrelated possibilities, an unexpected change in the normal operating characteristics of main reduction gearing can present technical staff with more than a bit of a mystery. So where to start?

In this case the engineering personnel on board HMCS *St. John's* (FFH-340) made the right call by calling in the formation gearing inspector from Fleet Maintenance Facility *Cape Scott* to assess the noise in the gearbox and determine its origin. As we have learned[1] from HMCS *Kootenay's* tragic lesson in 1969, an unknown noise in something as critical as the main reduction gearing needs to be investigated immediately.

Continued on next page...

First assessment

The following actions were taken to try to narrow down the cause of the noise:

- While turning the gearing and shaft in the ahead direction, we crawled over, under, and around the gearbox to attempt to focus in on the source. The noise seemed to be coming from inboard;
- We removed the sight-glass covers over the upper intermediate shaft gears, upper idler and primary pinion and visually inspected the gears while turning. Nothing unusual was detected;
- We turned the gearing and shaft in the astern direction and the noise stopped immediately. [Note that the synchro self-shifting (SSS) clutch automatically engages when turning astern.];
- Turned ahead with the clutch engaged – no noise;
- Disengaged the clutch by applying the gas turbine brake and turning ahead;
- Turned ahead again and the noise returned.

The clutch was then "pawl freed" to check the lock-out operation and see if it had an effect on the noise:

- With the clutch pawl freed there was no noise turning ahead or astern;
- The operations to and from lock-out had no issues.

Description of the noise

The noise was a steady and synchronous "knock" that could be easily heard all around the starboard gearbox. It was most prominent inboard, in the vicinity of the SSS clutch. In this area it could also be felt in the gearbox lube oil supply piping and on the gearcase.

Timing of the "knock"

The "knocks per minute" were timed and found to be approximately 70 per min. While turning with turning gear, the gas turbine (GT) input shaft turns at 2.286 rpm. At slow speeds, with the gas turbine input shaft stationary, the clutch primary pawls are in action. It was determined that there are 30 ratchets on the primary ratchet ring. Multiplying the 2.286 rpm X 30 = nearly 70, corresponding roughly with the 70 knocks per minute. Was this a clue or happenstance? Another observation was that the oil flow out of the clutch through the exit holes in the output clutch ring pulsated in synch with the knocks when the noise was present.

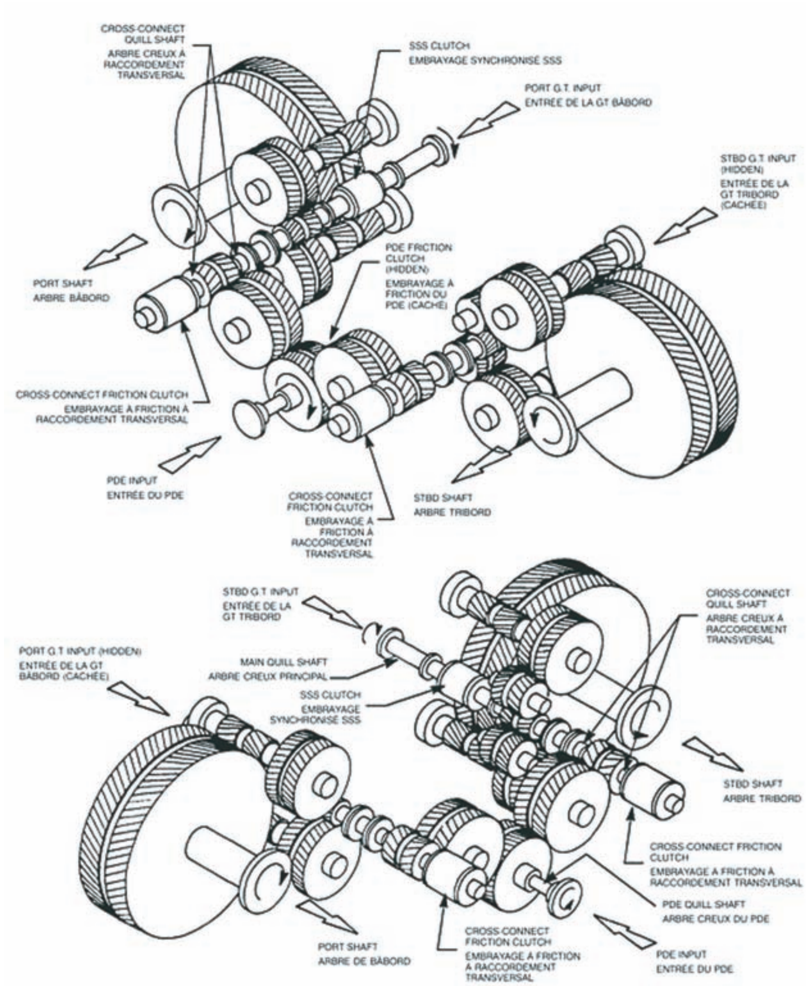

Figure 1. The gear component relationship on board the *Halifax*-class frigates[2].

SSS CLUTCH BASICS

SSS clutches have been used by the Canadian navy since the *Iroquois*-class destroyers were built in the 1970s. Their reliability has been impeccable.

Each GT input shaft incorporates an SSS clutch mounted on the first primary pinion shaft. The SSS clutch is a positive, tooth-type, overrunning clutch which is self-engaging when passing through synchronism, i.e. the clutch engages immediately when the speed of the input shaft overtakes the speed of the output shaft. Engagement and disengagement are completely automatic. The clutch will commence to disengage immediately on torque reversal, i.e. when the output shaft runs faster than the input shaft.

The SSS clutch is entirely mechanical, with no controls, friction plates, hydraulics or electromagnetic devices being required. Clutch slip cannot occur, nor can the clutch be engaged or disengaged inadvertently.

The clutch is held in the engaged position by a hydraulic lock fed from a locking oil valve in the gearbox lubricating oil system. This lock prevents disengagement under transient torque reversals which may occur for a few seconds during a crash astern manoeuvre. The SSS clutch locking oil valves are operated pneumatically from the pneumatic clutch control cabinet.

The manually operated lock-out key feature enables the operator to lock the clutch in the disengaged position with the gearing stationary, thereby inhibiting automatic engagement. In this position the components of the clutch are free to rotate without engaging. This permits the associated gas turbine to be tested without the clutch engaging.

The SSS clutches have micro-switches that provide remote indication of the clutch position. A mechanical indicator on the gearcase gives local indication. In addition, the cover of the lock-out key has a micro-switch interlock to prevent the remote assumption of control over the turbine when the clutch is locked out. When the cover is removed, a signal indicates to the IMCS [integrated machinery control system] that the lock-out key has been inserted, thereby invoking safety interlocks.

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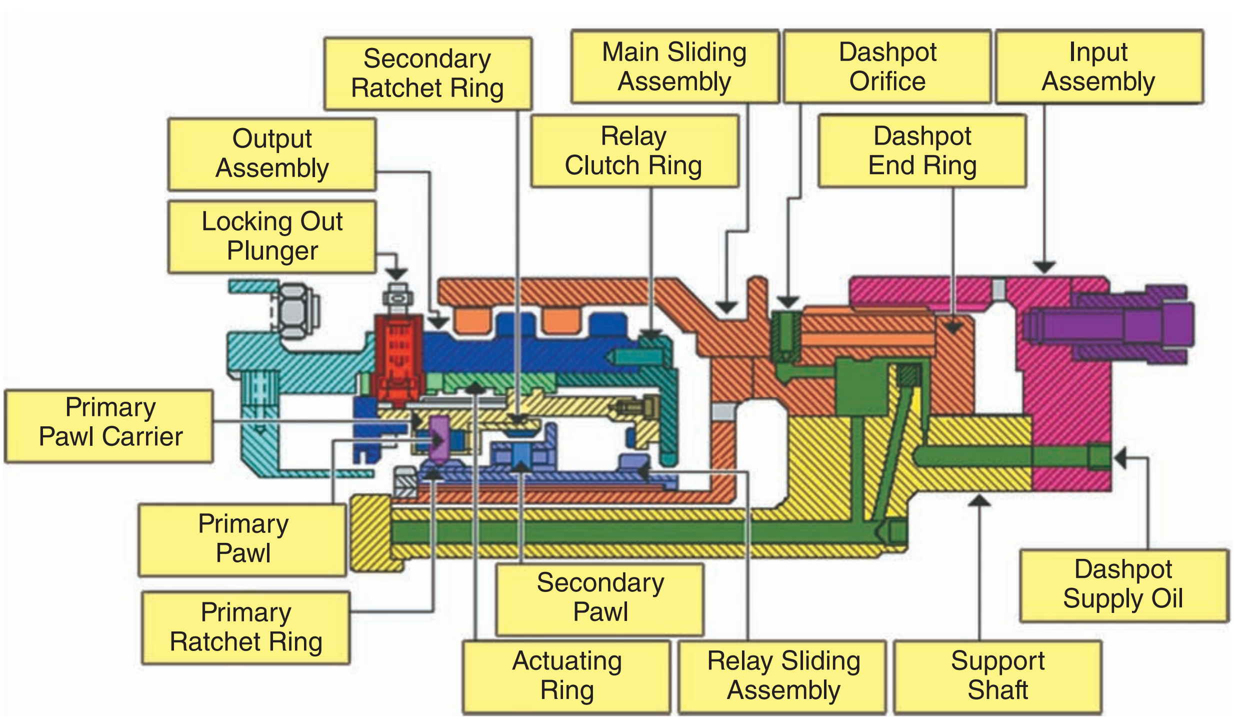

Figure 2. Simplified detail of the main components of the SSS clutch.
(Courtesy Canadian Forces Naval Engineering School Halifax)

What the initial investigation revealed

- The noise coming from the starboard gearbox while turning with turning gear was emanating from the SSS clutch;
- The noise could possibly be related to the primary pawl/ratchet ring area of the clutch;
- There appeared to be abnormal movement of the clutch internal parts when the noise was present, thus causing the oil pulsations;
- Ship's staff indicated that there had been no prior issues with the operation of this clutch;
- The noise from this clutch was highly unusual and abnormal;
- There was an unknown defect in the internal parts of the clutch.

At this point the DMSS 3 propulsion systems section of the Directorate of Maritime Ship Support in NDHQ was consulted and discussion began with the SSS Clutch Company, the original equipment manufacturer (OEM) of the clutch. The OEM recommended that the clutch switch unit be removed to see if it had any influence on the noise. This would also give better exposure to the clutch in order to feel and hear the knock.

The switch was removed, the knock persisted, and it was confirmed further that the noise was being produced by the clutch. At this point it was decided to replace the clutch since there was no further action that could be taken without disassembling the unit and examining its internal parts.

Repair by replacement

The RxR began in April 2010 by removing interference items such as deck plates, piping, sensors, cable trays, etc. Jigs were manufactured to provide jacking points for the section of gearcase that had to be removed to provide access to the clutch. Once the clutch was removed, the flange-to-flange (GT shaft to primary pinion shaft) and GT flange run-out readings were checked. The new clutch was installed and given a functional trial with turning gear. A basin trial was successfully carried out, testing full operation of the clutch.

The old clutch was transported to the mechanical fitter's shop at Fleet Maintenance Facility *Cape Scott* where a partial disassembly and cursory visual inspection were conducted. Overall, the condition of the internal components seemed to be very good, with no obvious indication of any excessive wear or damaged parts. Primary and secondary pawls had minor wear that would be completely acceptable and expected for the age and hours of operation. Primary and secondary ratchet ring teeth had minor wear as expected. The thrust ring bearing surface was defect free. The helical splines for the relay and the main sliding components were defect free. The main clutch teeth and relay spur gear teeth had minor evidence of wear as expected.

One thing that was unusual was that there was a fairly significant build-up of sludge in some areas – another clue? The majority of the sludge was found in the vicinity of the primary pawl retaining ring and relay clutch ring. It is surmised that the sludge build-up was due to the centrifugal action of the clutch on the clutch lube oil supply, where contaminants could be separated out and accumulate over the life of the clutch.


Step 1. The gearcase section is readied.


Step 2. The gearcase section is removed.


Step 3. The exposed clutch assembly is disconnected.


Step 4. The exposed clutch is lifted out using a single transport bracket.


Step 5. FMFCS mechanical fitter Jim Rankin (foreground) and author Bob Steeb check the flange run-out readings.


Step 6. HMCS *St. John's* Mar Eng Mech Leading Seaman Shawn Luciano takes advantage of the training opportunity.


Step 7. The replacement clutch with its transport brackets installed.


Step 8. FMFCS mechanical apprentice Jake VanRossum (left) and FMFCS rigger Justin Burke rig the new 265-kg clutch in place.


Step 9. The partially disassembled clutch sits on the bench for visual inspection at FMF *Cape Scott.*


Step 10. The relay sliding assembly showed no defects.


Step 11. The input assembly (shown here removed from the main sliding assembly) also showed no defects.


Step 12. A significant build-up of sludge in some areas indicated where contaminants had accumulated over the life of the clutch, and might also have been related to the noise problem in the clutch.

Continued on next page...

The Investigation Continues…

Definitive proof of the cause of the noise within the clutch still eludes discovery, so the file remains open pending a full report from the OEM. This information would be valuable in establishing if there are unknown defects in this specific clutch (causing the noise), and would offer an expert assessment of the overall condition of a clutch that has been operating in a *Halifax*-class propulsion plant for more than 15 years.

The Author

Bob Steeb is the gearing and gas turbine machinery inspector at Fleet Maintenance Facility *Cape Scott*. He is a former marine systems engineering officer, commissioned from the ranks.

References:

1. Tremblay, Claude: "HMCS *Kootenay* – 40 Years of Lessons Learned," *Maritime Engineering Journal*, No. 65, Fall 2009 / Winter 2010, pp. 16-20.
2. CFTO C-24-293-000/MS-001, *Halifax* Class Main Propulsion System Operation and Maintenance Instructions with Parts Identification List, 1997-04-25, p. 2-1-7.

REVIEWS

DESIGN SPACE ANALYSIS USING THE STRATEGIC PLANNING AND PRIORITIZATION METHODOLOGY

By Cdr Jacques Olivier, Dr. Stéphane Dufresne and Dr. Santiago Balestrini-Robinson
Illustrations courtesy the authors

Introduction

The *Canada First Defence Strategy* (CFDS) directs the recapitalization of the Canadian fleet by mandating that, starting in 2015, fifteen new surface combatants of a common hull design are to be built to replace the capabilities currently resident in the Iroquois-class destroyers and subsequently the *Halifax*-class frigates after modernization. While all these vessels will be based on a common hull design, the frigate and destroyer variants could be fitted with different technology sets, e.g., weapons, communications and surveillance systems, in order to maximize the fleet capabilities while meeting the desired budget threshold.

Problem Definition

Partly as a result of the downsizing in the 1990s, DGMEPM's capability to assist major crown projects in the fields of ship concept design, costing and systems engineering was significantly eroded. Consequently, there is a need to develop an organic tool capable of capturing the complex interactions between design choices in order to evaluate the cost-capability impact of evolving requirements on ship systems and concepts. Such framework would enable the acquisition team to perform rapid and dynamic cost-capability analysis, allowing the identification and evaluation of technically feasible and economically viable ship concepts during the early phases of the procurement process.

There are several daunting challenges related to the design of systems as complex as naval surface combatants. The evolution of operational requirements, emergence of new threats and changes in the world order, development of new technologies, market uncertainty, currency volatility and fixed-budget constraints are a few examples of critical assumptions that can drastically change the warship configuration. The design of future naval platforms must therefore take into account the interoperability of a variety of systems and their role in a larger "system-of-systems" context to minimize uncertainties and project risks.

Design Space Analysis

Among the many tools available to explore design options and their implications is the Design Space Analysis (DSA) methodology. To that end, the Aerospace Systems Design Laboratory (ASDL) of the Georgia Institute of Technology has been performing DSA studies using their Unified Trade-off Environment (UTE) process since the early 1990s. The UTE process was developed by ASDL for the aero-propulsion industry and was subsequently adapted in the late 1990s to warship applications for the US Naval Surface Warfare Center through sponsorship by the Office of Naval Research in collaboration with the Center for Innovation in Ship Design.

The UTE process uses systems engineering principles to establish the complex interdependencies between hierarchical factors such as operational requirements, design parameters and technology selection. Furthermore, this process establishes traceable relationships to determine the impacts of the design characteristics on performance and costs, and their sensitivities to initial assumptions. The design space can thus be optimally analyzed by performing multidimensional space analysis in real time as opposed to sequential point design explorations as generalized in Figure 1.

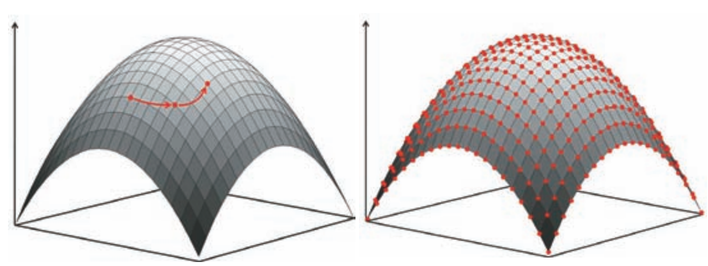

Figure 1. Point Design Explorations compared to the UTE Design Space Analysis

Source: Aerospace Systems Design Laboratory of Georgia Institute of Technology

Continued on next page...

Although implementation of the UTE process is divided into five iterative phases, this paper examines only the first phase of the UTE process, namely problem definition. This phase is most vital because it provides decision-makers with a structured, traceable and transparent framework in which to create relationships between several levels of abstraction from geopolitical-level military ambitions to tactical-level platform capabilities. The usefulness of the subsequent phases is predicated on how well the correct and pertinent information was captured and linked during the problem definition phase using the ASDL Strategic Planning and Prioritization (SP2) process.

Strategic Planning and Prioritization

Figure 2 illustrates the SP2 process and its associated steps as applied to the acquisition of a notional surface combatant. The scope of planning envisaged a fixed-budget procurement process potentially taking 10 to 15 years within which period high volatility was assumed in terms of political, economical, societal, technological, legal and industrial developments. The organizational goals were taken from the mandated CFDS core military roles and missions which were functionally decomposed and prioritized using a top-down approach. Through a series of facilitated workshops with subject matter experts and modern voting techniques, models are created to enable mapping from the CFDS roles and missions to operational-level joint domestic and expeditionary CF activities, then to contributing naval functions, and finally to ship's capabilities corresponding to key performance parameters.

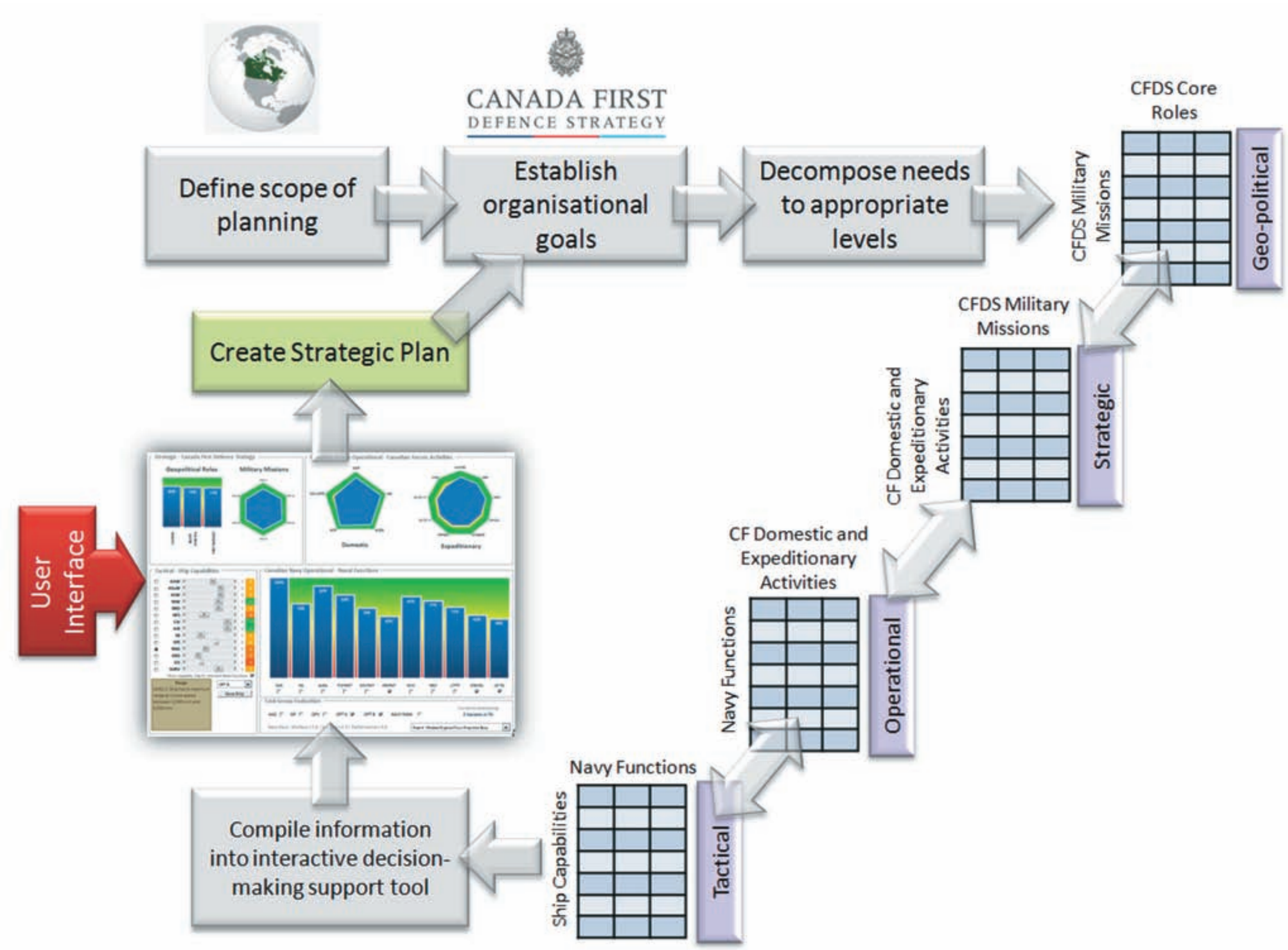

Figure 2. Strategic Planning and Prioritization (SP2) Process

The results from the SP2 voting are synthesized into a portable decision-making support tool that allows team members to perform interactive scenario-based trade studies and dynamically visualize the outcomes. The SP2 tool can show not only where there are shortcomings in capabilities, but also where there is excess capability in performing a given naval function. The tool is therefore a synthesis of the knowledge and experience of the naval officers participating in the workshop process. Its value lies in allowing stakeholders to obtain a holistic and parametric decision support environment which answers exploratory questions in real time without the need to constantly elicit new information from the subject matter experts. As the project and assumptions evolve, this process should be used as a living document to store and rationalize the assumptions, decisions and design changes shaping strategic road-mapping and capability-based planning. For example, Figure 3 show a possible ship variant optimized for domestic operations with limited Arctic patrol capabilities.

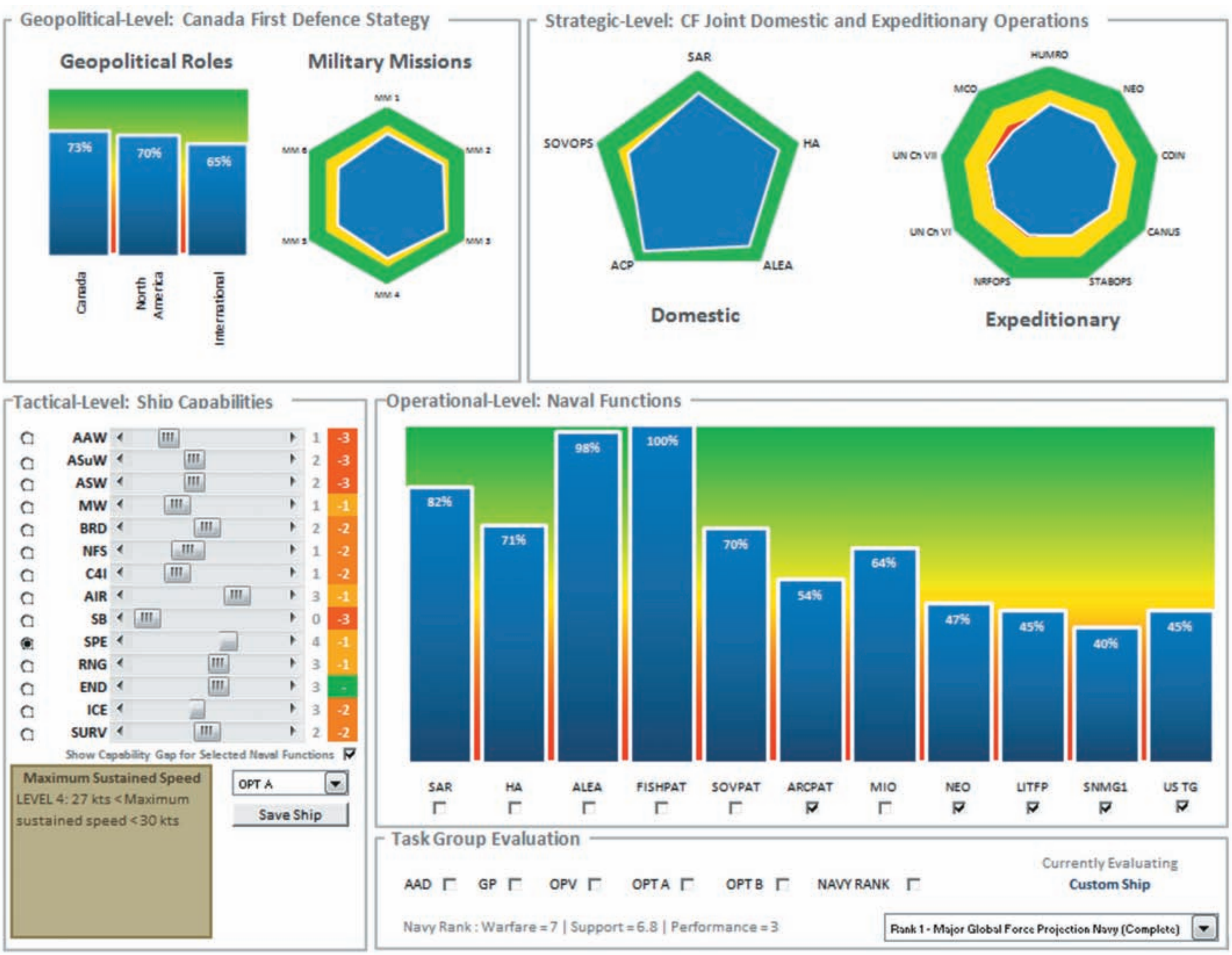

Figure 3. SP2 Visualization

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Benefits of the UTE Process

It is important to note that the UTE process is a framework that can be tailored to a wide spectrum of programs and applications. From a managerial perspective, the process helps to synthesize the navy's strategic goals such that a robust tool is produced to readily defend difficult cost-capability trades. The construction of this framework requires numerous interactions between the project stakeholders, which invariably improves team communication and in turn focuses the vision of the program through the chain of command. This tool enables either a top-down flow of the force-level requirements to the equipment's key performance parameters or a bottom-up evaluation of candidate ship designs with their contributions to the achievement of the force-level requirements. The capability to rapidly inform senior management on the cost-capability trades in the early stages of design will help reduce the overall project execution risk.

From an engineering design perspective, the tool allows for the selection of the most desirable ship designs taking into account the effect of uncertainties surrounding the design parameters and the cost data. Consequently, the resulting trades provide the decision-makers with a higher confidence of achieving geopolitical ambitions and strategic-level operational requirements based on collectively generated tactical-level assumptions rather than personal intuition. The information gathered from these trades can be used to refine the statement of operational requirement or the system requirements document with greater knowledge of the impact on the cost-capability of the design.

Photo by Robert Combier

The design space analysis team (left to right): Dr. Chris Raczynski, Dr. Santiago Balestrini-Robinson, Dr. Stéphane Dufresne, Cdr Jacques Olivier, Mr. Sean Tobin, Dr. Simon Briceno, Dr. Yongchang Li.

Conclusion

The UTE-SP2 process is one among the many analysis tools available to project directors and managers. The overarching objective of the UTE process is to develop an interactive decision-making support tool capable of rapidly conducting traceable cost-capability trades. It is a means to increase the collective understanding of the risks and uncertainties plaguing major naval crown projects by reducing the paradox of making the most important and influential decisions early during the conceptual design phase, while having the least knowledge and information on critical factors and interdependencies.

The *Canada First Defence Strategy* established the road map so that the next generation navy will continue to monitor and defend Canadian waters and make significant contributions to international naval operations. This will support the CF commitments to deliver excellence at home, be a strong and reliable partner in the defence of North America, and project leadership abroad. The design of such combat-capable, flexible and multi-role surface combatants is, however, besieged by difficult challenges: coping with unknown future global threats; using disparate technologies, some not yet fully developed and others nearing obsolescence; attracting sailors not yet conceived; and building to cost over a long horizon in the face of unknown commodity, currency and labour fluctuations. Only time will tell.

Authors

Cdr Jacques P. Olivier CD, MSc, MBA, P.Eng, PMP, was the Platform Systems Manager for the Canadian Surface Combatant Project from August 2008 to 2010.

Dr. Stéphane Dufresne is the Advanced Concept Division Chief at the Aerospace System Design Laboratory of the Georgia Institute of Technology.

Dr. Santiago Balestrini-Robinson is the Naval Systems Engineering and Integration Branch Chief at the Aerospace Systems Design Laboratory of the Georgia Institute of Technology.

March 24, 2011

2010 NAVAL TECHNICAL OFFICER AWARDS

Naval Officers Association of Canada (NOAC) Award

The NOAC Award is presented annually to the candidate with the best academic performance and officer-like qualities on completion of the Naval Engineering Indoctrination Course. **SLt Michael Machnee** was unable to attend for the presentation of the award shield and the book, *The Ships of Canada's Naval Forces 1910-1985*, from Cmdre (ret.) Mike Cooper, NOAC.

Mexican Navy Award

The Mexican Navy Award is presented annually to the candidate with the best academic standing and officer-like qualities on the NCS Eng Applications Course. Mexican Naval Attaché Captain Herrera Romo presented the award plaque and Mexican naval sword to **SLt Devin Kester**.

L-3 MAPPS Saunders Memorial Award

The L-3 MAPPS Saunders Memorial Award is named in memory of Lt(N) Chris Saunders. It is presented to the candidate with the best academic standing and officer-like qualities on the MS Eng Applications Course. Gwen Manderville and Wendy Allerton (L-3 MAPPS) presented the award plaque and the *Modern Marine Engineer's Manual* to **SLt David Stewart**.

MacDonald Dettwiler Award

The MacDonald Dettwiler Award is presented annually to the best overall naval technical officer who achieves Head of Department qualification. Richard Billard of MacDonald Dettwiler presented the award plaque and naval sword to **Lt(N) Matthew Webb**.

Weir Canada Award

The Weir Canada Award is presented annually to the best overall Phase VI candidate who achieves MS Eng qualification. Serge Lamirande, Weir Canada Inc., presented the award plaque and naval sword to **SLt Victor Armes**.

Lockheed Martin Canada Award

The Lockheed Martin Canada Award is presented annually to the best overall Phase VI candidate who achieves NCS Eng qualification. **Lt(N) Meryl Sponder** accepted the award plaque and naval sword from Don McClure of Lockheed Martin Canada.

A photo of award winners and runners-up appears on our inside front cover of this edition of the Journal.

Photographs by Cpl Ron Kinnie, Formation Imaging Services, Halifax

NTO
SPIRIT AWARD

Photo by Brian McCullough

Rear Admiral (ret.) Ian Mack, Director General (Land & Sea) for Major Project Delivery, presented the annual Naval Technical Officer branch Spirit Award to **Lt(N) Adrian Mascarenhas** (right) at the HMCS *Bytown* wardroom prior to the National Capital Region NT mess dinner on February 3. East Coast nominee **Lt(N) John Faurbo** (left) was runner-up.

Both officers were recognized for their outstanding "spirit raising" contributions – Lt(N) Mascarenhas for his work as the *Bytown* entertainment officer and support of naval centennial events, and for his selfless volunteer work with Sea Cadets and Navy League in Ottawa; Lt(N) Faurbo for his inspiring motivational involvement in a Mini-Grey Cup event and Army/Navy football tournament (Navy won, of course), and for his creativity as a co-designer of an NTO Centennial Table for the Stadacona wardroom in Halifax.

The inscription on the front of the silver plate (donated by RAdm Mack) reads: *The NTO Spirit Award, presented to NTO's whose demonstrated character epitomizes the spirit that enables Naval Technical Excellence, Presented by RAdm (Ret'd) ID Mack*. The back of the plate is inscribed with the words: *Inspired by SLt Jeff Murray who ran EXPRESS* (fitness test) *in Full Mess Kit the morning after the Halifax NTO Mess Dinner 2009 and raised $1180 for Palooka's* (after school program for kids).

"Bravo zulu" to both officers.

NTO
TABLE TURNOVER

Presentation photos by Brian McCullough. Inset photo by Cpl Robert Leblanc, Formation Imaging Services Halifax

Table co-designer Lt(N) John Faurbo, FMF *Cape Scott* CO Capt(N) Richard Gravel, mess president Cdr Lin Paddock, table builder Fleet Technical Officer Cdr Roger Heimpel, and the table's other co-designer, Lt(N) Chris Lien (photo inset).

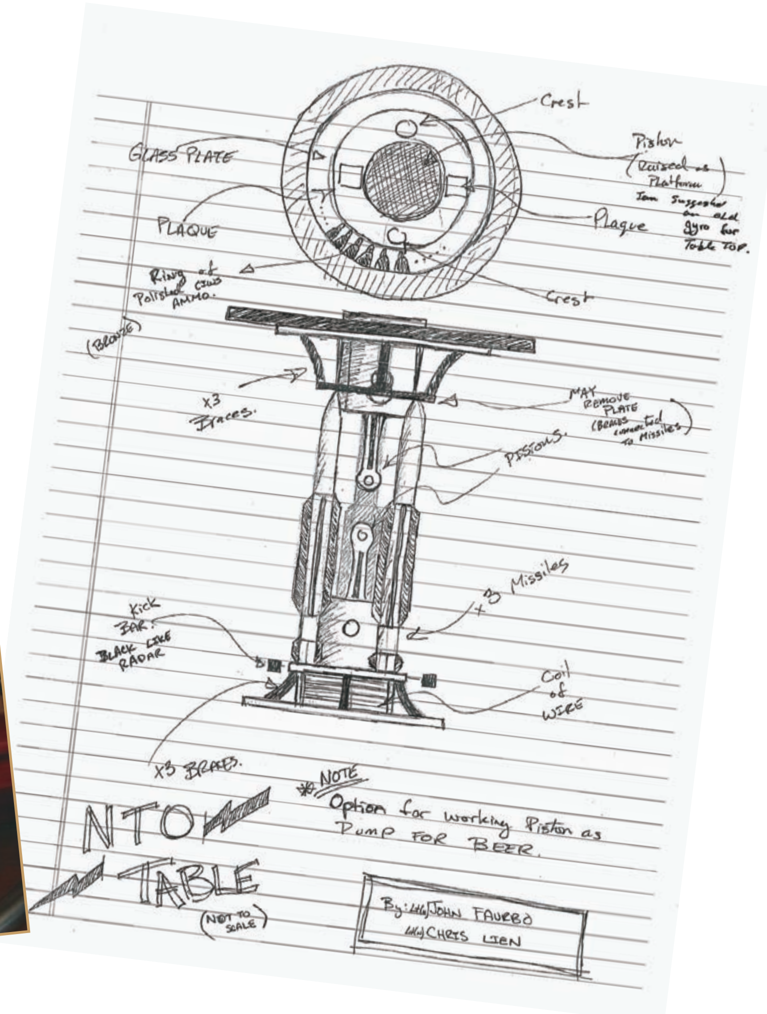
A naval centennial challenge project for junior Naval Technical Officers in MARLANT to design an "NTO table" for the Stadacona wardroom came to a cheerful conclusion with the winning entry's unveiling on March 23. On hand for the official turnover were table co-designer Lt(N) John Faurbo, FMF *Cape Scott* CO Capt(N) Richard Gravel, mess president Cdr Lin Paddock, and table builder Fleet Technical Officer Cdr Roger Heimpel. The table's other co-designer, Lt(N) Chris Lien (file photo inset) was participating in squash regionals and unable to attend the unveiling.

In constructing the table, Cdr Heimpel made everything except for the stainless steel foot rail which was fabricated by the FMF pipe shop, and the engraving which was done commercially. He followed the Faurbo-Lien design as much as possible, but admits that modifications were necessary. The designers, he said, "wanted a real piston and conn rod (way too heavy) and a real telegraph (again, 90 lbs was a stability concern)."

NTO table top design.

Continued on next page...


NTO table foot rail and leg support detail.



MARITIME FORCES ATLANTIC NAVAL TECHNICAL OFFICERS TABLE

Naval Lieutenants John Faurbo and Chris Lien provided the original design for the table. During construction, modifications were made to the design.

The foot rail is a stainless steel ring meant to historically represent the Main Engine throttles used on board the steam-driven destroyers.

The pistons and connecting rods mimic those found in the MWM 850-KW diesel generators.

The missiles are versions of the Enhanced Sea Sparrow Missile (ESSM).

The table top inlays represent the major war vessels in the 2010 Atlantic Fleet, engraved into 57-mm casings fired at sea during TGEX Fall 2010 by HMCS Fredericton and HMCS Charlottetown.

The Engine Room telegraph mimics the one on board HMCS Sackville.

The brackets holding the table top are grooved with three beads to represent the three MOSIDs associated with Naval Technical Officers.

The feet of the table each have three fingers, with four feet making a grand total of twelve fingers, one for each major war vessel depicted on the table top.

The table, like all of us, has flaws but remains functional.

— Cdr Roger Heimpel, builder of the table

NEWS BRIEFS

NATO SEASPARROW – CO-OPERATIVE BUSINESS MODEL KEY TO *HALIFAX*-CLASS ESSM UPGRADE

By Jon Walman

When HMCS *Regina* (FFH-334) completes testing on her newly installed Evolved SeaSparrow Missile and Mk 48 vertical launch system this fall, she will become the last of the *Halifax*-class frigates to upgrade from the previous generation RIM-7 missile. The first Canadian ESSM was launched from HMCS *St. John's* (FFH-340) in the fall of 2004.

The versatile ESSM, which is now in service on board approximately 230 ships worldwide, is a short-to-intermediate range self-defence missile that is guided via active radar and midcourse data uplinks. The missile extends a ship's tactical battlespace and provides reliable self-defence capability against agile, high-speed, low-altitude anti-ship cruise missiles, low-velocity air threats such as helicopters, and fast manoeuvrable surface craft.

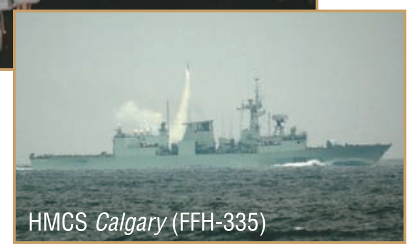
The dozen *Halifax*-class frigates carry 16 ESSM RIM-162 missiles, which are fired by the Canadian Mk 48 vertical launch system. In-service support for the Mk 48 VLS is provided by the Naval Engineering Test Establishment Mk 48/56 ISEA facility located in Dartmouth, Nova Scotia.

The ESSM program is a co-operative effort among 10 of 12 NATO SeaSparrow nations that is governed by various memoranda of understanding. In addition to Canada, the other ESSM user nations are Australia, Denmark, Germany, Greece, The Netherlands, Norway, Spain, Turkey and the United States. The NATO SeaSparrow Project Office (NSPO) located in Arlington, Virginia provides management oversight and life-cycle technical expertise for the ESSM program and its associated systems, as well as third party sales to several other nations.

NSPO's co-operative business model is especially attractive to partner nations during challenging economic periods when countries are seeking to reduce defence spending without damaging their industrial base. A work-share arrangement mandates that the prime contractor shall employ industrial partners from the consortium nations. For Canada, Honeywell of Mississauga, Ontario provides various parts for the missile's control section.

According to LCdr Kevin Mac Dougall, the SeaSparrow project's national deputy for Canada, NSPO's co-operative missile procurement and cost/work-share approach have saved the Canadian navy millions of dollars, while delivering reliable ship self-defence capability.

Photos courtesy the author



HMCS *Calgary* (FFH-335)

The RIM-162 Evolved SeaSparrow Missile carried on board the *Halifax*-class frigates offers much greater defensive capability than the RIM-7 missile it has replaced. A modified guidance section includes a quick-start feature for rapid response, while an improved warhead section delivers more significant firepower. The 25-cm (10-inch) diameter rocket motor provides higher thrust for longer duration, and the tail-steering thrust vector controller gives the ESSM its improved capability against anti-ship cruise missiles and other manoeuvring threats.

"As NATO's largest and longest-running [43 years] co-operative weapon development project," Mac Dougall explained in an interview for this article, "the consortium's success results from its ability to satisfy the evolving operational requirements of multiple nations, and [from] the missile's design flexibility to integrate with a host of different launchers and complex shipboard weapon system configurations."

Jon Walman is the communications manager for the NATO SeaSparrow Missile Project Office in Arlington, Virginia. For more information on NSPO or the ESSM, visit ***https://www.natoseasparrow.org/default.aspx****.*

PRESERVING CANADA'S NAVAL TECHNICAL HERITAGE

CNTHA NEWS

Canadian Naval Technical History Association

CNTHA's WAY AHEAD

CNTHA News *Est. 1997*

CNTHA Chairman
Pat Barnhouse

CNTHA Executive Director
Tony Thatcher

Directorate of History and Heritage Liaison
Michael Whitby

Maritime Engineering Journal Liaison
Brian McCullough

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Please address all correspondence to the publisher, attention Michael Whitby, Chief of the Naval Team, Directorate of History and Heritage, NDHQ
101 Colonel By Dr
Ottawa, ON K1A 0K2
Tel. (613) 998-7045
Fax (613) 990-8579

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www.cntha.ca

More than 15 years into its mandate to investigate and preserve the story of Canada's naval technical heritage, the CNTHA has re-examined its mission, vision and goals with the aim of charting the way ahead with clear objectives and renewed focus. The new statements reflect a more unified approach to the CNTHA's important contribution to the overall Canadian naval historical record.

Mission

To capture and preserve Canada's oral and written naval technical history.

Vision

To encourage the establishment of a culture in which Canada's naval technical heritage is preserved and made accessible to future generations.

Goals

A. To collect and document information on Canada's naval technical history with a focus on:
   1. progression of the use of new or different technologies in naval technical activities;
   2. effects of the navy's procurement and construction activities on the defence industry;
   3. technical infrastructure supporting naval platforms and equipment (e.g. standards, quality assurance, project management, procurement approach, documentation, role of the ship repair unit, etc.); and
   4. recruitment, training and development of naval engineers.

B. To increase accessibility to Canada's naval technical history.

(Goals A1-4 will be achieved through the CNTHA's oral history program and technical working groups. Goal B will be achieved through the CNTHA website and various other communication activities.)

Oral History Program

The following goals for the oral history program have also been endorsed by the committee:

1. Maintain a list of prospective interviewees and the reason for the interview;
2. Assign interviewer(s); and
3. Identify specific lines of inquiry (by seeking input from other CNTHA members, reviewing previous related interviews, reviewing the output of the working groups, and following up on controversial/conflicting statements made in collected material).

Working Groups

Activities regarding the establishment and operation of focused working groups to support the updated CNTHA goals now include the following guidelines:

1. establish working groups and WG leaders;
2. identify technologies, activities and types of infrastructure that should be investigated;
3. establish specific goals and dates;
4. identify key persons of interest within each area of activity;
5. conduct working group sessions; and
6. keep/prepare records that are suitable for the Directorate of History and Heritage and the CNTHA website. These include:
   - audio recordings with indexing;
   - synopses of sessions in paper copy (document, spreadsheet or database);
   - timelines showing linkages between critical events;
   - notes of constraints, assumptions and other factors that influenced events; and
   - records of differing opinions or points of view.

The Canadian Naval Technical History Association continues to make significant progress in piecing together the stories that make up Canada's fascinating naval technical heritage. This labour of love is shouldered by a small group of mostly older volunteers who would enjoy hearing from others who are interested in joining the team and making their own important contribution to the historical record. We welcome you all.

– Pat Barnhouse and Tony Thatcher