



A History

of the

Canadian Industry Warship Design

Capability

1945 to 2002



James R. Williams



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INTRODUCTION

Canadian Navy personnel, both active and retired, formed a group to collect various historical details of the technical content of the Canadian Navy under the banner of Canadian Naval Technical History Association (CNTHA). During its initial deliberations it was defined that Canadian Industry had a major role in the areas of design, build, outfit, equipment, etc, and a sub-committee was organized in 2002 named Canadian Navy Defence Industry Base (CANDIB) to research these aspects of purely indigenous Industry contribution. The Navy had previously bought and operated warships of foreign design and, in most cases, then modifying those warships to better withstand the Canadian operating environment. This publication is the basis of the resulting Section of the CANDIB Report dealing with the indigenous Warship Design capability.

Many people contributed data to this publication, and my thanks are extended gratefully herewith for that cooperation – they are listed in the appropriate sections herein. Wherever possible, I scanned the original documents into my computer and reproduced them *in toto* to eliminate any prospect of incorrectly stating their facts. Any additional interpretation of these data that may be in error are solely the responsibility of the author. Similarly, references to published documents (numbered in parentheses) used in this publication are listed and included in a Chapter at the end of this publication.



The largest new warship design in Canada – the Halifax FFH 330 Class Frigate



SUMMARY

The CANDIB study of the *Defence Industrial Base*, which served the Canadian Navy from the beginning of World War II to the present time (2002), has been primarily in the *Design, Build, Outfitting and Maintenance of its warships*. During that 57 years period the progressive reduction of the need for such a large Navy resulted in a progressive reduction of warships and resulting Navy manpower. In parallel, the ever smaller defence budgeting by the Federal Government over time required the Navy to reassess both its warship and its manpower requirements to the point where its uniformed manpower needed to be directed more and more towards its ship-borne operational requirements and away from its on-shore support activities. This allowed Industry the opportunity to also do some of the Navy's on-shore logistics management functions. In the years closing out the 20th century the *on-shore Logistics and Operational Support* activity was consequently also part of Industry's *Defence Industrial Base*.

Historically, prior to 1945 the Navy had bought its larger ships offshore and in some instances built its smaller vessels in Canada but to foreign designs. It also bought existing commercial vessels and converted them to the Navy's required use. At that time Canadian Industry did not have the capability to design and build the larger, more complex warships. However, *World War II* saw both Canada's Navy *operating* larger warships provided primarily by the UK Royal Navy, and Canadian Shipyards being required to *build* large quantities of smaller ships, thus driving Canadian Industry to expand its *shipbuilding* capability. *Immediately post war*, the Navy decided to also build up its own *design* capability. An expanded infrastructure was therefore required. Canada had a well-defined commitment in its post World War II membership in NATO, viz. an anti-submarine responsibility in the North Atlantic. The shipyards were available - the design element of this infrastructure was missing.

The Navy chose to encourage the setting up of a design capability by Canadian Industry, and in such a manner as to allow the Navy to oversee the work and consequently to grow its own expertise in parallel with the Industry capability. This led to a specific form of **Directed Contract**, euphemistically named NCDO (Naval Central Drawing Office).

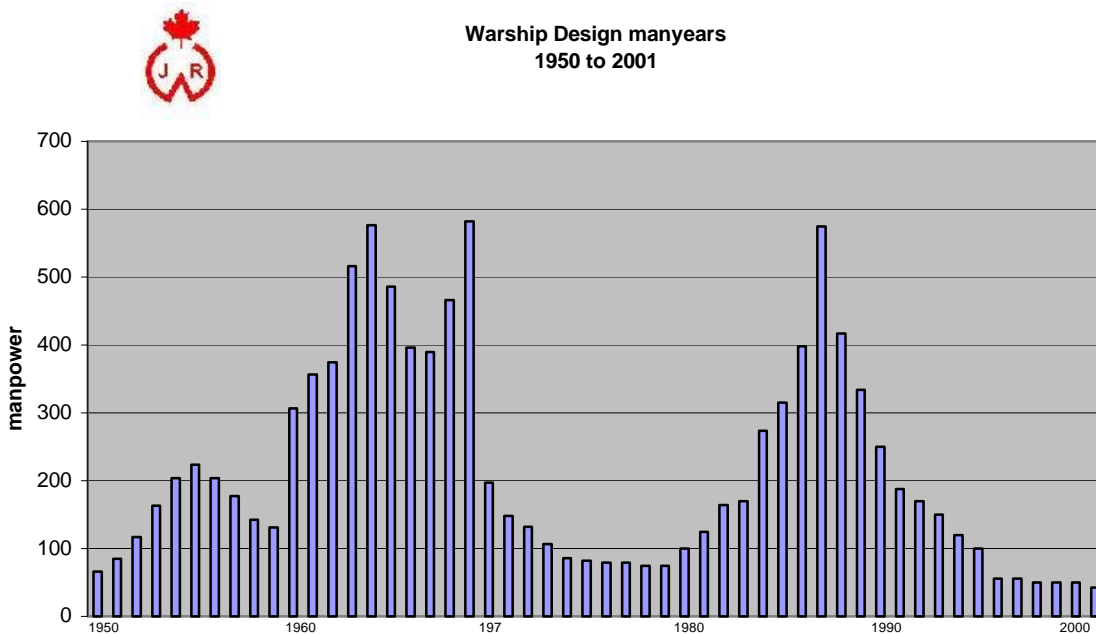
This publication deals first with the history of that Design capability in a narrow focussed manner, from which later emerged a broader Industry design capability, and the progression of the Government's contracting practise for ship design and maintenance from **Directed Contract** to a broader base **Competitive Contract**.

This publication shows that in 1949 the Navy encouraged Industry to build that major warship design capability, only to see it dispersed in 2002 through (a) lack of sustainable business from the Navy, and (b) in the Navy not continuing its in-service ship support with that original NCDO company that had accumulated that experience of the previous 52 years.



The Navy developed its own Dockyards located at Esquimalt, BC and at Halifax, Nova Scotia for its day-to-day requirements for physically maintaining the ships in up-to-date fighting configuration. The Navy also developed and retained its own on-shore Research & Development capability manifested in the Department of National Defence (DND) Defence Research Establishments that were primarily staffed by civilian employees of DND. The Navy also developed and retained its own Engineering cadres within DND, also staffed by civilian as well as uniformed personnel.

A realistic summary of this warship design capability is offered as the accompanying graph, completed with the appropriate man-year content of all warship design activity made by Canadian Industry on behalf of the Canadian Navy in this time period. This includes new ship designs and existing ships' conversion designs. It does not include the Production Engineering work, which is a function of the Engineering Department of the individual shipyard to convert the Design Drawing package that was normally produced in accordance with the prevailing Canadian Forces Technical Order (CFTO) specification of the Navy, to conform to the individual shipyards' own unique tooling and construction methods. Neither does it contain any design work by Canadian equipment Suppliers to the indigenous ship build and outfit programs. The following chart contains all known warship design work during the period 1950 to 2002.



The foregoing chart covers the initial design and modification of all the warships listed below.



WARSHIP CLASS LISTING

COMPANY	DESIGN ACTIVITY	WARSHIP CLASS
Canadian Vickers	<i>NCDO/NSDA (1949-1974)</i> St. Laurent class et al AOR's Bonaventure refit	DE's thru DDH 280's AOR 508's 22
Vickers Stanwyck	<i>MDDO (1974-1976)</i>	
Versatile Vickers	<i>MDDO (1976-1987)</i> DELEX refit (start) Halifax Class (start)	FFH 330's
de Havilland	Bras d'Or	FHE 400
MIL Systems Engineering	<i>MDDO (1987-2002)</i> DELEX refit (finish) Halifax Class (finish) TRUMP refit	FFH 330's DDH 280's
Saint John Shipbuilding Ltd	Halifax Class *	FFH 330's
Fenco MacLaren	Kingston Class	MCDV 700's

* SJSL is understood to have contracted *off-shore* the majority of their part of the basic ship design



1 Overview

The most enduring **industrial** activity empowered by the Canadian Navy was the initiation and subsequent support of a Naval Warship design capability in Canada. Perhaps the best basis for measuring the work of this element of the Canadian Navy Defence Industrial Base is the number of man-hours provided by Industry in its support to the Navy; some might argue that dollars paid by the Navy for this work is a better measure, and certainly to the managers of this service in Industry it was more important than man-hours, but the latter is the common denominator between different companies and was in fact the basis on which the Procurement Agent for the Navy agreed to the invoicing by Industry: in fact the Department of Supply & Services (DSS) measured how “honest” Industry was through the use of its own Audit Service Bureau which audited down to the Man-hour level plus Overhead structure of individual companies.

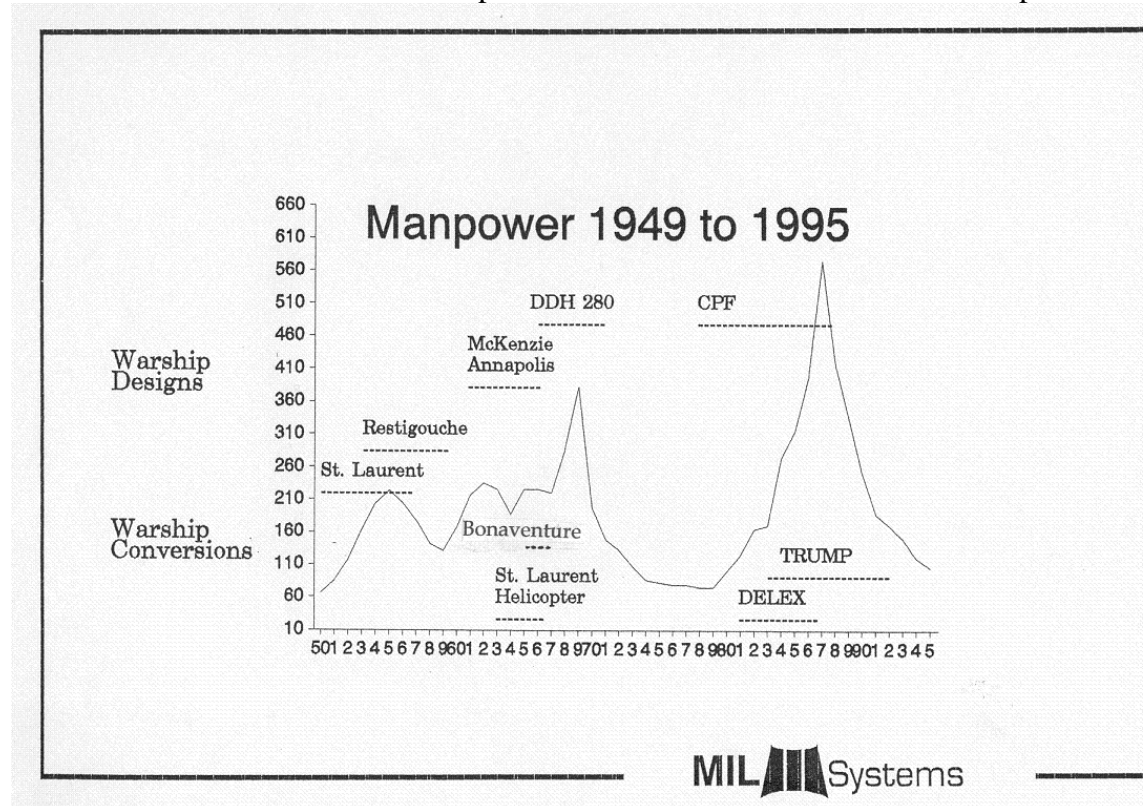


Fig. 1 Ship Design & Maintenance Engineering Manpower employed from 1949 to 1996 by the original NCDO Team (2)

This initiation of the Naval Warship Design Capability was driven by the Navy’s intention, subsequent to the end of World War II, to design its own warships for its specific regional environment rather than to continue the practise of buying warships offshore, principally the United Kingdom, then modifying them to better suit the Canadian environment. The opportunity



arose when the Navy decided it needed new and different destroyers in the post war era. The Navy designated this requirement as the St. Laurent Class. The Navy looked at various ways in which their design requirement could be accomplished. The Canadian Vickers Shipyard in Montreal proposed an acceptable solution, viz. that it would set up a dedicated design team in its Montreal facility. It had a quid pro quo, however, which the Canadian Navy accepted, i.e. that Canadian Vickers would be the lead shipyard in the build of the seven St. Laurent class warships the Navy wanted (1)

Thus, on the one hand, in 1949 Canadian Vickers set up the required design team from its current staff and integrated the technical capability it was otherwise lacking by incorporating experienced design people from other Canadian shipyards and from United Kingdom shipyards. A core group of some 60 people resulted, which expanded and contracted as the workload of design fluctuated over time. It eventually reached a peak in the early 1990 timeframe of 605 personnel when it was simultaneously *maintaining* the Navy's operational ships, *converting* the DDH 280 class ships to TRUMP configuration, and *designing* the FFH 300 class Canadian Patrol Frigate. Figure 1 shows the changing staffing over time with respect to some major design activities.

On the other hand, the technical offices at Naval Service Headquarters were not initially staffed as a warship-design authority. The Engineer in Chief's department was expanded from 5 officers in 1948 to 21 officers plus civilian engineers and technologists over the next 4 years. The Engineer in Chief's department reported to the Chief of Naval Technical Services, and CNTS itself grew from 84 people in 1948 to approximately 400 by 1956, itself also recruiting expert personnel, both uniformed and civilian, many from the United Kingdom.

The previous graph shows the peaks and valleys of manpower required to provide the Navy with its design agent service for new ship design, existing ship modernization and existing ship maintenance. Obviously not all tasks are shown. After 1995 a basic core group of about 60 people continued to be employed on maintenance taskings, and during the 1990 – 2000 timeframe the last of the original core group of the initial Canadian Vickers dedicated design team reached retirement age. A younger group of naval architects and marine engineers, who learnt their trade with the original design team personnel, continued to provide the design requirements of the Navy.

The terms NCDO, NSDA and MDDO need to be explained. They are the names given to the method of contracting by the Department of National Defence used to provide the Industry design team who worked first in Canadian Vickers and subsequently to its successor Industry entities culminating in MIL Systems Engineering Inc. From 1949 to 1972 the work of the NCDO contract included an overseeing function by the Navy through its Principal Naval Office, and were "level of effort" contracts requiring Canadian Vickers to provide specific numbers and types of technical personnel. In 1972 these contracts were put out to General Tender on a "cost plus fee" basis, and initially included a requirement for dual management, i.e. one Industry and



one Naval. The acronyms stand for Naval Central Drawing Office, Naval Ship Design Agency and Marine Design Draughting Office, respectively.

As time went by the configuration of the fleet of the Canadian Navy reflected the changing requirements of the role it was intended to play. The excellent publication by MacPherson and Burgess titled “The Ships of Canada’s Naval Forces 1910-1981” (**17**) and its subsequent revisions “1910-1992” and “1910-2002” (**21**) covers in great detail the changing warships’ configurations. In particular, the “1910-2002” issue contains a clear description of each warship and its details of commissioning and ultimate retirement (when applicable) as it was replaced by more modern warships which better suited the ever changing Navy operational roles’ requirements. It is reproduced here to take advantage of that clarification and to show why the new indigenous design capability was employed.



PART IV 1990–2002

INTRODUCTION

When the Berlin Wall came down in 1989 and the Cold War ended with unexpected suddenness, the Canadian fleet remained essentially unchanged from that of 1975. Increasingly derided by journalists as “rusted-out” and irrelevant, the Navy literally and figuratively was running out of steam. It was with a certain degree of astonishment, then, that Canada’s initial response to Iraq’s invasion of Kuwait in 1990 was to hastily refit the destroyers *Athabaskan* and *Terra Nova*, along with the supply ship *Protecteur*, for service in the Persian Gulf. That they were able to acquit themselves well in a theatre of action very different from the North Atlantic for which they had trained was due as much to the resilience of the ships’ basic design as to the high quality of the men and women who sailed in them.

There was also the fact that a new generation of weapons and equipment was available to be fitted into the ships before their departure. Approval had been granted in the late 1980s for the rebuilding of the *Iroquois* (DDH-280) class under the Tribal Update and Modernization Program (TRUMP), and for the construction of a whole new class under the Canadian Patrol Frigate (CPF) program. Although none of these ships were ready for operational deployment, many of the new modular systems (such as the Phalanx Close-in Weapons System and Harpoon anti-ship missiles) could be fitted to the older ships. Indeed, even as they sailed to the Gulf, the lead ship of the CPFs, HMCS *Halifax*, was undergoing acceptance trials. The remaining steam destroyers gradually were paid off so that their crews could undertake conversion to the new types (the last to go was *Nipigon* in 1998).

Over the course of the last decade of the 20th century, Canada’s Navy accepted the four rebuilt ships of the *Iroquois* class, as well as twenty-four new ships: besides the twelve CPFs, there were twelve Maritime Coastal Defence Vessels (MCDVs), for use primarily with the Naval Reserve for training and the renewal of a mine countermeasures (MCM) capability. As these latter ships



became available, the *Bay* class minesweepers and *Anticosti* and *Moresby* were withdrawn from service. By the end of the decade, the *Oberons* also were gone, being replaced by the *Victoria* (ex-*Upholder*) class of four diesel submarines acquired from the Royal Navy. Only *Protecteur* and *Preserver* remained of the Cold War fleet, and a project for their replacement was being defined under the Afloat Logistics and Sealift Concept (ALSC).

If the "Persian Excursion" was the last war cry of the Cold War fleet, Canada's "New World Order" Navy very quickly found itself engaged at a higher operational tempo, as real-world brush-fire crises replaced the routine of peacetime exercises. The Turbot Crisis on the East Coast, illegal Chinese immigration on the West, and continued instability in Haiti all ensured gainful employment in home waters. Canada consistently commits a destroyer or frigate (and occasionally an oiler) to the Standing Naval Force Atlantic. Twice in the past decade, STANAVFORLANT deployed out-of-area to the Adriatic Sea for operations against the former Yugoslav Republic, each time coincidentally under the command of a Canadian commodore employing one of the *Iroquois* class as his flagship. The *Halifax* class frigates were engaged prominently elsewhere, through their individual integration in rotation into US Navy carrier battle groups in the Persian

Gulf, enforcing United Nations sanctions against Iraq. Besides their traditional fleet replenishment role, *Preserver* and *Protecteur* were dispatched for humanitarian assistance operations, respectively to Somalia and East Timor. The *Oberons* discovered a new utility in covert fisheries patrols. MCDVs ranged across the Atlantic for NATO MCM exercises, and were among the ships to respond to the Swissair Flight 111 disaster in Peggy's Cove.

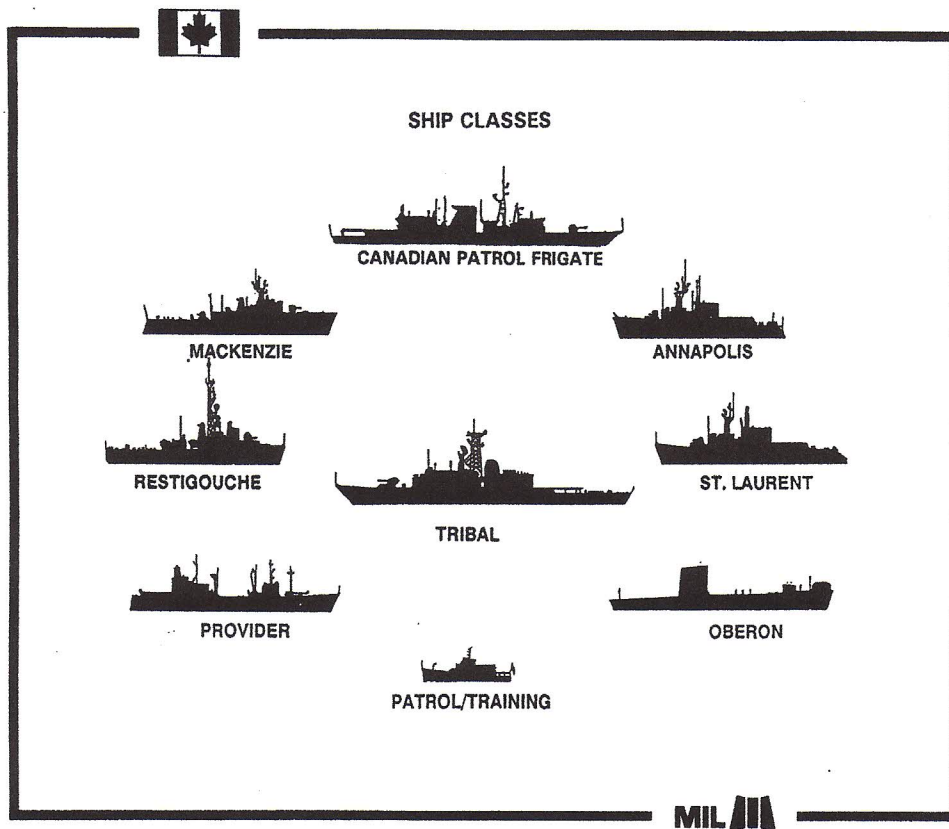
On the date of writing this introduction in November 2001 a Canadian task group comprising HMC ships *Iroquois*, *Charlottetown* and *Preserver* passed through the Suez Canal to the Arabian Sea for operations against the Taliban forces of Osama bin-Laden in Afghanistan, and three other frigates (*Halifax*, *Vancouver* and *Ottawa*) also are engaged with USN carrier battle groups. A fourth frigate, *Toronto*, has joined the SNFL operating in the Eastern Mediterranean in support of the war. Through the 1990s, the Canadian Navy effectively was rebuilt into the "multi-purpose, combat-capable" force envisioned in the 1994 Defence White Paper, and the Canadian government was finding it to be of increasing utility in meeting the challenges of the twenty-first century.

LCDR (ret'd) Richard Gimblett



2 Timelines

The roughly 60 years covered by this review saw the industry holders of the Warship Design contracts by the original core team of experts assembled by Canadian Vickers change Corporate affiliation due to the normal cut and thrust of the business world, viz: Canadian Vickers (1949), then teamed with Stanwyck to form Vickers Stanwyck (1974), then dropped Stanwyck and teamed with Versatile to form Versatile Vickers (1976), then sold out in toto to the MIL Group who renamed the design team MIL Systems Engineering (1987). Other Canadian companies also won system and equipment design contracts from DND/DSS under specific ship class contract titles, outside the NCDO/MDDO program, but these are not germane to this study. The following silhouettes are those of the major ship classes covered by the NCDO/MDDO contracts by the original (NCDO) Design Team over the period 1949 to 1996, as well as the CPF (Halifax Class frigates) the Prime Contract of which was held by Saint John Shipbuilding with a directed sub-contract by DSS to MIL Systems Engineering for 100% of the Concept Design and some 70% of the Detail Design and the associated Production Drawings. Design contracts outside the MDDO purview were also awarded to de Havilland Canada for the design of the Bras d'Or, and Fenco MacLaren for the design of the MCDV.



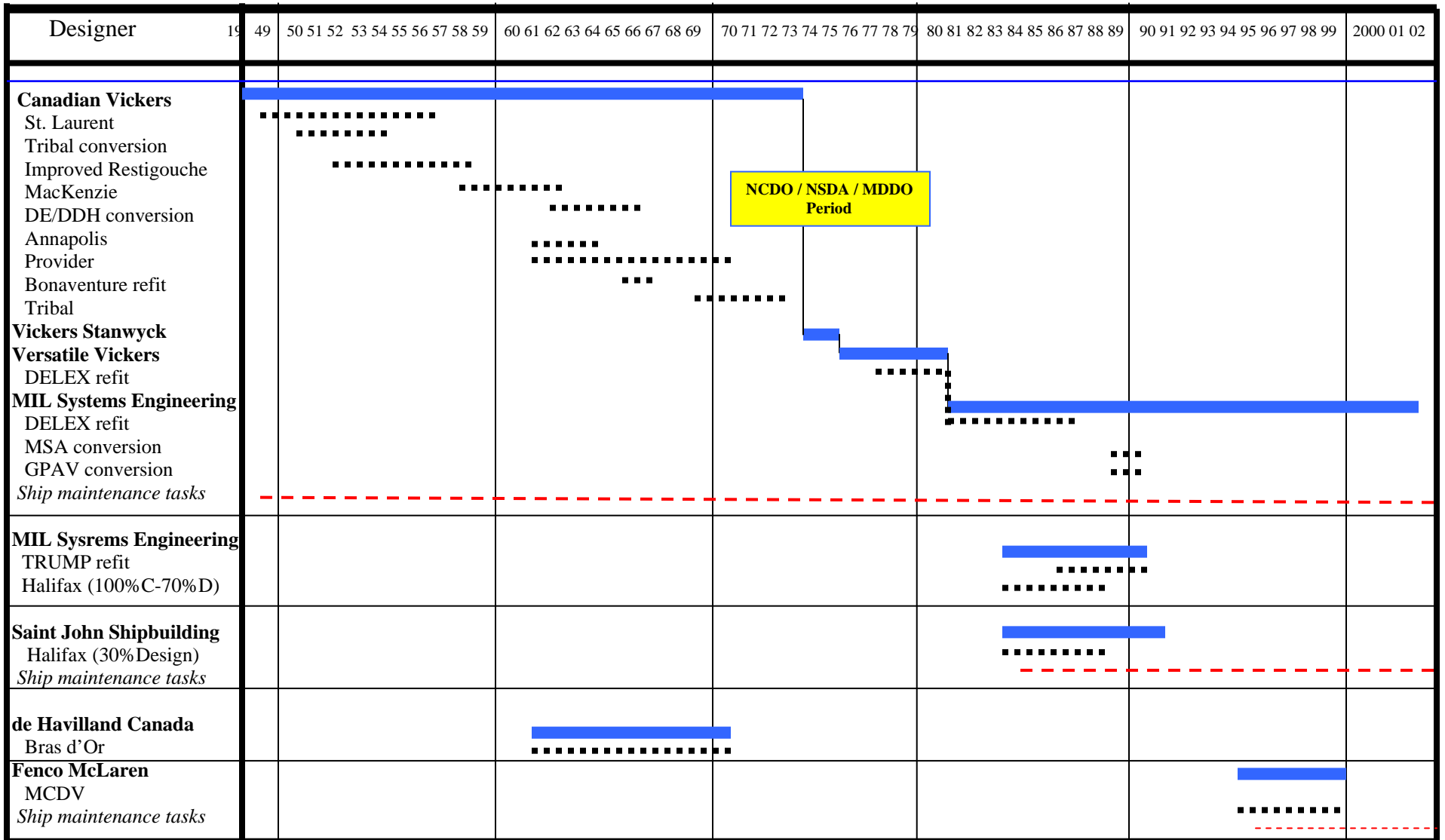


The Canadian Government had a policy in the early years after World War II of spreading the *build* of the Navy ships across Canada from coast to coast. Economies of scale were initially put aside in the interest of political equity, but as time went by the cost became too great and the shipbuilding industry was directed by the Federal Government to rationalize itself. No longer were 7 lead ships tolerable (as was the case of the 7 St. Laurent Class in 7 different shipyards), and the latest new warship program covered by this review saw all 12 ships built in one shipyard (the MCDV 700 class built in Halifax Shipyard, Nova Scotia).

The following Timeline chart shows the *activities of all the Warship Design Houses* during the period of this review.



WARSHIP DESIGN HOUSES' TIMELINE



NCDO / NSDA / MDDO
Period

■ Design Houses
 ■■■■■■■■■■ Ship Class Design Activities
 - - - - - In-service Navy Ship Class Maintenance Taskings



3

Evolution of the Design Houses

Prior to 1949 there were no recognizable Design Houses in Canada capable of designing a major warship. Individual shipyards had Design Teams (Engineering Departments) but none had the expertise or the scope to design major warships.

The Canadian Navy decided it wanted to have such a capability and in its review of how such a capability could be put in place, a solution was proposed by Industry (Canadian Vickers of Montreal) in 1949. The proposed solution was accepted by the Navy, and the indigenous Canadian Design House had its beginning. The then current new destroyer requirement of the Navy (the St. Laurent class) was the first project to challenge this burgeoning element of Canadian technology. The history of its inception and the evolution of this warship design capability is the subject of this Section of the Study.

This Chapter contains papers from a number of sources:

- 3.1** The Navy's Central Drawing Office employs 60-odd Draftsmen – a 1952 perspective by Lt. (SB) B. J. Gillespie, RCN
- 3.2** The NCDO history from the perspective of MIL Systems Engineering Inc. – by Jim Williams, retired President & CEO, MIL Systems Engineering Inc.
- 3.3** NCDO to MDDO History – a perspective by Tom Campbell and Dave McKenzie both were original members of the NCDO Design Team, and Tom retired as Senior Vice President, MIL Systems Engineering Inc.
- 3.4** NCDO to MDDO Period – a perspective by Alec Patterson, retired as Program Manager, MDDO, MIL Systems Engineering Inc.
- 3.5** Some Reflections on Ship Design – 1949 to 1989 by Bill Craig, retired as a Manager of Engineering Design, MIL Systems Engineering Inc.



3.1

The Navy's Central Drawing Office employs 60-odd Draftsmen

— a perspective by Lt. (SB) B. J. Gillespie, RCN (20)

The following is a verbatim typescript of an article by then Lt. (SB) B. J. Gillespie, RCN published in the magazine "Canadian Shipping" in March 1952. The copy of the article on hand is not of a quality that it can be scanned, hence this typescript. The article describes the NCDO contract activity from a Navy point of view, whereas all the previous accounts in this publication are from the perspective of Industry people. The title is a little humorous when viewed today 51 years later in that today we would have used the term "60 plus" rather than "60-odd" because in our politically correct world of today the latter implies that the people involved were not quite normal (whereas in fact they were all expert in a then high technology field of engineering).

Out of earshot of the clanging steel and grinding machinery in the shipyards of Canadian Vickers Limited, Montreal, there is an obscure office where a group of highly skilled unassuming experts work side by side in hushed silence.

It is here in the Naval Central Drawing Office that much of the detailed thinking is done for the shipyards concerned with the Royal Canadian Navy's multi-million dollar shipbuilding program.

Supervising this vital operation on behalf of the navy is a soft-spoken man who has spent half a lifetime in the shipbuilding industry. He is Constructor Captain Frank Freeborn, RCN, of Halifax and Amherst, N.S., Principal Naval Overseer, Montreal.

Manning the drafting boards and drawing tables are some 60 hull, machinery and electrical draughtsmen, most of whom are new Canadian citizens or in the process of becoming Canadian citizens. Like Captain Freeborn they too have spent most of their life building ships some in the Clyde, others at Tyneside or at Belfast. They came to Canada two years ago, when the drawing office opened, to take up a new job in a new country and to apply a brand new shipbuilding technique.

The new antisubmarine escort vessel is the drawing office's number one project. The basic design of this new ship is worked out by the technical branches at Naval Headquarters and is approved by the Naval Board. Then the information is passed on to the Naval Central Drawing Office, where draftsmen convert the ideas into drawings. The first drawing is made in pencil. This is checked by a checker, an experienced draftsman, before it is submitted to Naval Headquarters for approval. If modifications are indicated by technical officers concerned in Ottawa, the draftsman makes the necessary changes when the drawing is returned. It is then traced on linen tracing cloth from which blueprints are made in quantity for supplying Canadian shipyards simultaneously.



This system of one source providing all yards with the same pattern assures that the vessels of a class in the RCN fleet of the future will be sister ships in all respects irrespective of the shipbuilder.

The drawings themselves leave nothing for the shipbuilder to guess at. Each unit of the new escort vessel is the subject of many detailed drawings, each containing complete details of material to be used and instructions on how to fit it into the monstrous jigsaw puzzle. The wealth of detail contained in the individual drawings facilitates mass production – the unit could be manufactured anywhere and in turn assembled at a shipyard.

Captain Freeborn estimates that close to 3,000 drawings will go into the development of the new escort. Into each drawing will have gone many hours of cool calculated thought.

Each draftsman is assigned one particular drawing and he stays with his assignment until it is finished. The drawings themselves vary in length from six to 15 feet and a unit drawing may take as long as eight weeks to complete. The new escort vessels comprise 83 units.

The Naval Central Drawing Office has other assignments besides the development of the new escort vessel. All requisitions for purchase orders are prepared here. The requisitions carry in detail the requirements and specifications for the article required. The current frigate conversion and minesweeper refit program is also channelled through the central drawing office.

Although it is located in Montreal, the drawing office is part of naval headquarters. Its proximity to the shipbuilding industry facilitates the application of new ideas in the development of a ship.

Another feature of the central drawing office which increases efficiency is that hull, machinery and electrical draftsmen work side by side in one office rather than each department operating a separate drawing office. Duplication of effort is avoided and ideas are easily amalgamated in the one combined office.

Original drawings are filed away in a large vault in one corner of the drawing office for safe keeping. It is anticipated there will be enough material, information and records after the prototype escort vessel commissions to enable the RCN to *make* its own instructions, rules *and* regulations with respect to RCN *ship* construction.

For security reasons all employees *of the* central drawing office are *thoroughly* screened.

Security is so controlled that it *would* be impossible to gather *enough* information from any one source to enable the ship to be built.

NOTE: *words in italics were not readily readable in the xerox copy.*



When the first escort vessel commissions the ceremony will be a milestone in the annals of Canadian shipbuilding history for it will be Canada's first major warship from design to commissioning. It will also be an occasion to break silence in the Naval Central Drawing Office and give three cheers for a "dream ship" come true.



CAPT. FRANK FREEBORN, RCN

Principal Naval Overseer, Montreal Area. Supervising the operation of the Naval Central Drawing Office is one of his many responsibilities. Capt. Freeborn, 47, comes from Halifax and Amhurst, N.S.