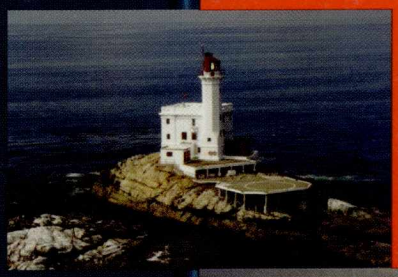
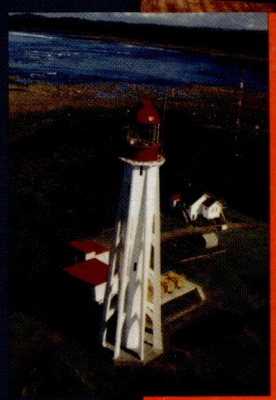
Research and Development

Annual Report 1999-2000





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17. Abstract

The Canadian Coast Guard annual report on its R&D activities, describing the research projects undertaken by the various branches and regions of CCG during the fiscal year 1999-2000.

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INTRODUCTION

The Program

The CCG's R&D program is oriented to meeting the challenges of increased expectations regarding marine safety, protection of the marine and freshwater environment, and support to ocean development. The priority of the R&D program is to support the CCG's operational, regulatory and procurement objectives. It's mission is to develop knowledge essential to the achievement of those objectives.

The R&D program is coordinated at Headquarters and delivered at the branch and regional levels. Senior management determines the overall direction and funding level of the program as established by the CCG's Strategic Plan. Each CCG branch delivers the program in the form of individual R&D projects. The branches also determine their respective internal project priorities, provide project management and secure funding and partnerships. The R&D Office provides policy advice, strategic direction and coordination.

CCG branches involved in R&D often draw upon the resources and expertise of other federal agencies such as the Transportation Development Center (TDC) and the National Research Council (NRC) as well as seeking cooperative funding from the National Search and Rescue Secretariat's (NSS) New Initiative Fund (NIF), and the Program for Energy, Research and Development (PERD). Many R&D projects are designed to assist the CCG to deliver its programs and accomplish its missions more cost effectively.

CCG is also involved in Joint Research Project Agreements (JRPAs) with other countries. Canada has a long history of successful JRPAs with Finland and the United States, confirming its reputation as a leader in marine technologies.

The Future

For the future, the CCG has as its highest overall priority the development of a new orientation to the marine information highway, which is focused on the enhanced use of critical information to enable improved navigation services at a lower cost. A second major theme is the promotion of sustainable transportation, involving a focus on minimizing the marine footprint of the world's oceans. Traditional priorities, which include safety of life, operational efficiency, and support to the domestic marine industry also, remain strong. The CCG will explore these and other opportunities by sponsoring R&D in these theme areas.

Unsolicited Proposals & Contracting Out

Government Services Canada receives, as part of its UP Program, unsolicited proposals that are written on the initiative of an individual or organization in the consulting, industry or knowledge sectors. Unsolicited proposals should satisfy a government science or knowledge requirement, and generally contain a unique idea or developmental opportunity.

Encouraging Canadian industry to meet government needs, stimulate industrial innovation and provide related benefits to the Canadian economy.

While Public Works and Government Services Canada (PWGSC) no longer has funding available to industry or the departments for the acceptance of unsolicited proposals, it does forward unsolicited proposals to CCG for consideration. CCG Branches that accept a proposal must procure funding from CCG core funds or external sources. Canadian Coast Guard did not receive any proposals for 1999-2000.

Most of CCG's mission-oriented science and technology requirements are contracted out to the private sector. In this way, CCG encourages Canadian industry to meet government needs, stimulates innovation, and provides related benefits to the Canadian economy.

INTRODUCTION

This Research and Development report reflects the delivery of the Canadian Coast Guard's (CCG) Research and Development (R&D) Program that support CCG's six business lines: Marine Navigation Services, Icebreaking Operations, Marine Communications and Traffic Services, Rescue, Safety and Environmental Response, Fleet Management and Corporate Services.

Marine Navigation Services provides, operates and maintains a system of aids to navigation, provides waterways development and maintenance, and ensures protection of the public right to navigation and protection of the environment.

Marine Communications and Traffic Services provides distress and safety communications and coordination, vessel screening to prevent entry of unsafe vessels into Canadian waters, regulation of vessel traffic movements, and management of an integrated system of marine information and public correspondence services. In addition to ensuring safe marine navigation, Marine Communications and Traffic Services' supports economic activities by optimizing traffic movements and port efficiency, and by facilitating industry ship/shore communications. All of the functions are derived from a regulatory framework based primarily on the Canada Shipping Act and the Safety of Life at Sea Convention.

Technical and Operational Services consists of the acquisition, maintenance, and scheduling of the DFO vessel and air fleets in support of the following DFO program areas: Marine Navigation Services, Marine Communications and Traffic Services; Icebreaking Services; Rescue, Safety and Environmental Response; Fisheries Management; Fisheries and Oceans Science and Hydrography; as well as exploring environmental technologies.

Icebreaking operations are those activities such as icebreaking escort, channel maintenance, flood control, harbor breakouts, ice routing and information services for marine traffic navigating through or around ice-covered waters, and for the general public. It also coordinates the movement of cargo for the annual re-supply of Northern settlements and military sites using contracted commercial carriers.

Rescue, Safety and Environmental Response conducts R&D in the following major program areas: marine search and rescue, environmental response and departmental national emergency preparedness; and the promotion of boating safety to the marine public through prevention and regulation.

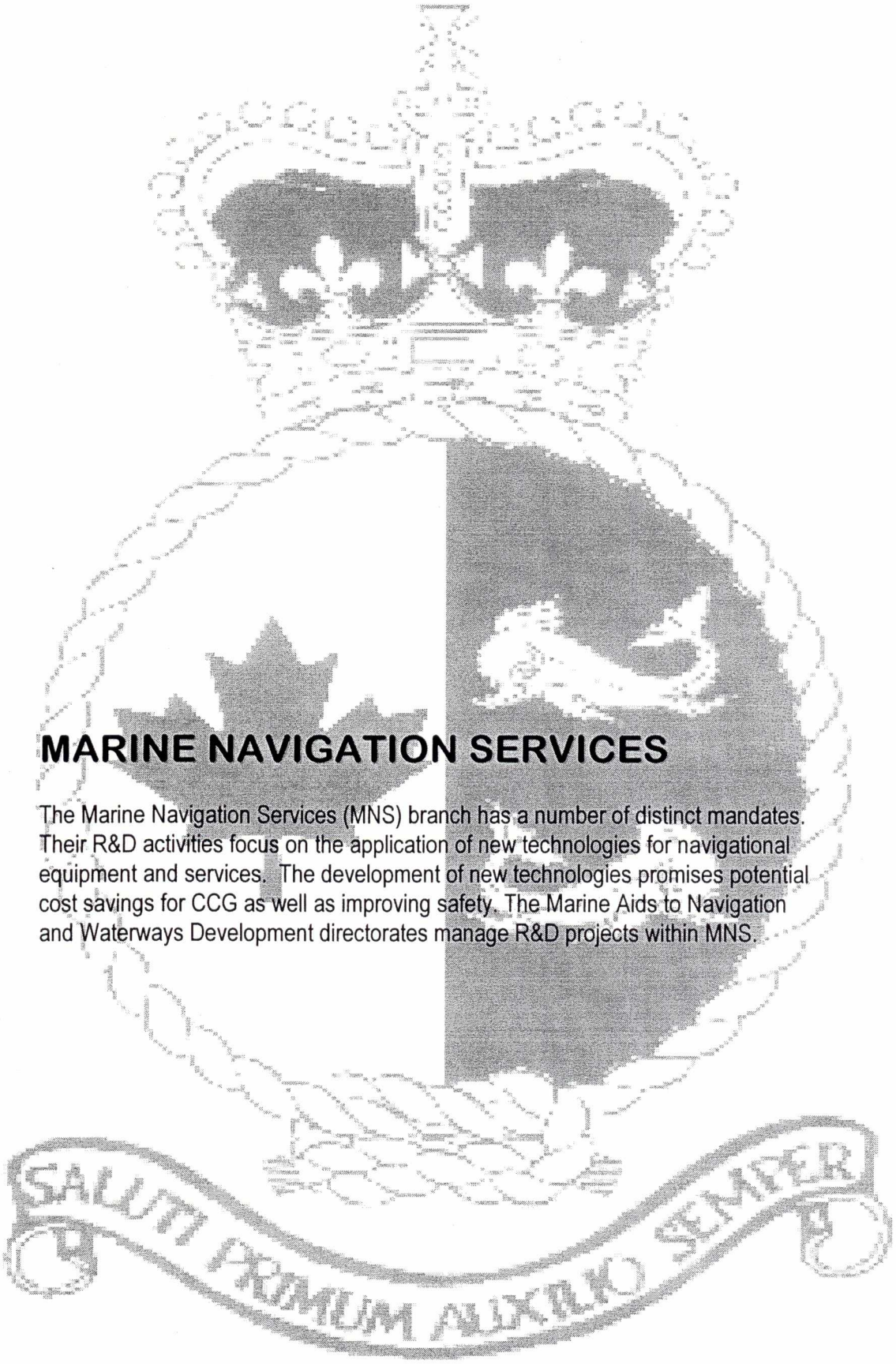
R&D office has the responsibility to establish goals, objectives, priorities, and accountability measures for the program that support CCG's Business Plan. It is also the program's focal point for resource/business management services, special projects and planning and coordination of the program.

A description of each R&D project undertaken by CCG during the 1999-2000 fiscal year may be found under their appropriate section heading. More details on these initiatives can be obtained by contacting the responsible project officers. A contact name and telephone number is given at the end of each project report.

Additional information on the R&D program, and/or a copy of the R&D Strategic Plan is available from:

Manager, Research and Development
Marine Programs, Canadian Coast Guard
200 Kent Street
Ottawa, Ontario
K1A OE6

Tel: (613) 990-3087
Fax: (613) 996-8902



MARINE NAVIGATION SERVICES

The Marine Navigation Services (MNS) branch has a number of distinct mandates. Their R&D activities focus on the application of new technologies for navigational equipment and services. The development of new technologies promises potential cost savings for CCG as well as improving safety. The Marine Aids to Navigation and Waterways Development directorates manage R&D projects within MNS.

Research & Development Plan
Year-End Budget Summary
1999-2000

PROJECT NUMBER	PROJECT TITLE	FUND SOURCE	1999-2000 FUNDS	
			CCG	PARTNER
FNBB6	Development of Laser Range Light	CCG	137	55
FNBH6	Development of a 5-Year Maintenance Free Buoy	CCG	178	

Marine Navigation Services – TOTAL		315	55

Development of a Laser Range Light

The Canadian Coast Guard (CCG) wants to reduce its costs in providing the services offered to navigation users. Laser technology has progressed in the recent years and now offers compact efficient visible sources at reasonable costs. Currently, range lights require two land sites at a significant distance from each other. The use of a laser range light would allow the CCG to offer the same level of service from a single site with much reduced real estate requirements and even increase the level of safety offered to the public.

Based on the good results of the first prototype developed in 1995, the aids to navigation group decided to continue the work with the National Optics Institute (INO) in Québec City for the development, installation, maintenance and evaluation of the two-color range light that was designed and partly constructed in 1998/99.

This two-color laser system is the main step of the laser development in CCG and should generate a product that meets the performance requirement of a lighted range system. The color seen by the users, red or green, will automatically give the port and starboard deviation from the center of the channel without any code interpretation like it was happening with the first one-color prototype. Only the degree of deviation will be given by a code which would consist of pulses of light transmitted at different repetition rates with respect to the angle of deviation.

The year's work has been the main step in the development of this laser range. The range has been designed and constructed and it is planned that field trials will be conducted in the late fall of 2000 around the Portneuf area in Laurentian Region. Technically advanced and sophisticated, this laser range will cover a range of 13 km and will utilize telephone lines for remote monitoring and coding programming. It will be possible to modify the codes emitted by the laser based on mariner's comments and needs. This will lead the CCG toward the completion of a final and commercial product.

In parallel to this project, a simplified version was developed for Central & Arctic Region. Installed in Hay River, NWT, the system of 3 km uses 20 milliwatt red and green lasers. It is powered by solar energy and is installed with a gunsight for easy alignment. This system helped in providing the necessary groundwork for the development of the more sophisticated system in Portneuf.

More info on the laser projects can be found on the CCG's intranet site of Aids to Navigation
(http://142.130.14.20/marineaids-aidesmaritimes)

Contact: Andre Chateauvert (613) 998-1405
Project Number: FNBB6

Development of a 5-Year Maintenance-Free Buoy System

The Canadian Coast Guard (CCG) continues to pursue new technologies as a means of modernizing its infrastructure with the goals of reducing costs and improving the efficiency of service delivery. During the short-range marine aids to navigation strategic planning process, it was acknowledged that economic benefits could be realized by the application of new technologies to buoy equipment and operations. A recent Project Team of HQ and Regional personnel identified major technical and operational areas to be addressed. The over-riding goal was set on the development of a total buoy equipment system that would operate, without servicing or maintenance, for a period of five years.

This goal has been achieved for most buoys by using high strength mooring chain, high performance coatings, solar power systems and ruggedized lights. However in a significant number of locations, the mooring chain still cannot stay on station for more than two years due to extreme bottom or sea conditions and many other buoys are being risk managed in years 4 and 5.

In order to achieve a reliable 5-year mooring for the difficult sites, work continued in the evaluation of alternative mooring systems. In 1994, CCG began a program of field testing a new mooring system in the difficult sites on the East Coast. This mooring system goes under the Trade Name of the Hurricane Mooring System, which was developed and supplied by Strait Moorings International Inc. of Shediac N.B. In 1999/2000, several modified moorings were deployed including one system with a large lighted plastic buoy in the Bay of Fundy. Break tests were conducted on several moorings, which have been in place for approximately five years, and an internal evaluation report was prepared. The report is accessible but was not published.

Contact: Reiner Silberhorn (613) 998-1411
Project Number: FNBH6

MARINE COMMUNICATIONS AND TRAFFIC SERVICES

The Marine Communications and Traffic Services (MCTS) branch seeks to improve distress and safety communication, manage an integrated marine information processing system, regulate vessel traffic movements, and to improve public correspondence systems. The R&D initiatives aim at providing the most cost-effective method and reliable performance to offer the best service possible in these areas.

Research & Development Plan
Year-End Budget Summary
1999-2000

PROJECT NUMBER	PROJECT TITLE	FUND SOURCE	1999-2000 FUNDS	
			CCG	PARTNER
FNVD6	Asynchronous Transfer Mode (ATM) Investigation	CCG	N/R	
FNVF6	Integration of AIS Surveillance into MCTS Operations	CCG	N/R	
FNVG6	Cooperative CCG/Industry Test of Universal (AIS) with Specific Application to the Placentia Bay/Hibernia Tankers	CCG	135	

N/R - Nil Report

Marine Communications & Traffic Services - TOTAL		135	

MARINE COMMUNICATIONS & TRAFFIC SERVICES

Asynchronous Transfer Mode (ATM) Investigation

The Canadian Coast Guard (CCG) operates a large number of operational systems that rely on digital communications networks. These digital networks interconnect equipment at CCG facilities and support CCG systems and applications. At present, networks are being reviewed and optimized in order to reduce costs, to support future CGRS/VTS amalgamation, and to support future applications (INNAV, DGPS, DSC).

Within industry, future networks, whether public or private, are expected to be based on Asynchronous Transfer Mode (ATM) technology. ATM is a high-bandwidth, connection-oriented, switched networking technology supporting multi-protocol, multimedia capabilities. It supports data, voice, and video traffic over the same network. In addition to solving many current interconnection problems, ATM will enable the creation of new applications that take advantage of the increases in speed and bandwidth. This in turn increases the efficiency and competitiveness of the organizations that implement ATM. The CCG has a strong interest in the successful use of this technology. ATM offers to provide high performance solutions at low cost for CCG digital networks. It also offers a standards based high performance network upon which to base future complex applications (i.e. INNAV, integrated bridge, etc).

The first year of this two-year project was to procure the hardware and firmware necessary to carryout an investigation on the capability and functionality offered by ATM. A detailed trial of the ATM capabilities and functionality against the needs of the CCG was to be performed during 1999-2000. There is no report available at this time. For further information, please contact the undersigned.

Contact: Marcel Bouliane (613) 998-1533
Project Number: FNVD6

Integration of AIS Surveillance into MCTS Operations

The new Universal Automatic Identification System (AIS) provides a means of very accurate and wide-area position reporting of ships, using economical shore-based and shipboard transponder technology. It is a system that has recently been accepted by maritime authorities around the world, and to which the IMO is currently directing its attention with a view to establishing mandatory carriage requirements. Initial tests of this system have been carried out in the St. Lawrence River with promising results. The Universal AIS will provide the Coast Guard with a means of replacing ageing surveillance infrastructure without incurring large costs in addition to contributing to a potentially lesser requirement for VHF radio communications.

AIS provides the Canadian Coast Guard with a means of replacing ageing surveillance infrastructure without incurring large costs, it also contributes to a lesser requirement for VHF radio communications. For the mariner, AIS provides a highly accurate situation display on board the vessel, and requires less disruption of routines because of lower requirement for communications with the MCTS Centre.

The Marine Advisory Board has clearly stated its desire and expectation for Coast Guard to move forward with AIS implementation. Tests conducted to date have focused on the technical merits of various AIS technologies, and not on the operational implications of integrating AIS into MCTS operations. This project is required to identify the complete range of potential for AIS as a MCTS surveillance tool. A decision to change the primary MCTS surveillance from one of radar to one of AIS or a combination of both (one complementing the other) can only be made if all operational implications are understood.

No report was submitted for this year. For all inquiries, please contact the undersigned.

Contact: Spencer Martin (613) 990-3020
Project Number: FNVF6

Co-Operative Canadian Coast Guard / Marine Industry Test of the Universal Automatic Identification System (AIS) with Specific Application to the Placentia Bay / Hibernia Tanker Vessel Traffic Movements

The new Universal AIS provides a means of very accurate and wide-area position-reporting of ships, using economical shore-based and shipboard transponder technology. It is a system that has recently been accepted by maritime authorities around the world, and to which the IMO is currently directing its attention with a view to establishing mandatory carriage requirements. Initial tests of this system have been carried out in the St. Lawrence River with promising results. The Universal AIS will provide the Coast Guard with a means of replacing ageing surveillance infrastructure without incurring large costs in addition to contributing to a potentially lesser requirement for VHF radio communications.

For the mariner, AIS provides a highly-accurate situation display on board the vessel, and requires less disruption of routines because of a lower requirement for communications with the MCTS centre.

For the marine Industry and the Atlantic Pilotage Authority (APA), AIS provides an opportunity for greater automation of port processes, and in the case of the APA would be complementary to a portable simulation system which they currently have under development.

Preliminary discussions have taken place with members of the marine industry and representatives of the APA who have expressed an interest in a co-operative test in which the partners would be the Coast Guard, the APA, the Hibernia oil consortium and local marine industries.

The following is a description of what was accomplished during this year's project:

MCTS had acquired and installed one (1) Saab Transponder Tech R3 Base Station Transponder at the Placentia Bay MCTS Centre, two (2) Saab Transponder Tech R3 mobile transponders (APA18 - Pilot Boat & the Hibernia shuttle tanker Mattea) as well as all associated hardware/software. Associated hardware/software included all necessary stand-alone computer equipment and associated Aldebaran II ECS (with AIS Module). MCTS also acquired 3 Saab Transponder Tech R2 Transponders which were utilized in the St. Lawrence Waterway AIS Pilot Project which took place in 1997/98. The R2 transponders without ECS were installed on the assist tugs Placentia Pride & Placentia Hope.

Two (2) Inmarsat C terminals were acquired to examine the long-range communication capabilities of the Saab Transponder Tech R3 transponder. The Inmarsat C terminals were installed on board the Hibernia shuttle tanker Mattea and at the Placentia Bay MCTS Centre.

MCTS also purchased and had installed a SeaTracker radar system from Sigma Engineering which provides ARPA target information to the base station at the Placentia Bay MCTS Centre from the radar site at Pearce Peak. The ARPA target information will be rebroadcast over the AIS frequencies to the R3 equipped vessels.

The CCG TEW Workshop performed extensive testing of the software to ensure operational and stability requirements prior to performing field installation.

MCTS operational personnel were able to provide valuable input into the further development of the AIS module of the Aldebaran II Electronic Chart System (ECS). Upgrades to the modules originally purchased for the R3 transponders were provided gratis to MCTS.

Due to delays in installation and equipment glitches operational testing was not sufficient in the given time frame to adequately assess the shore based and shipboard operational performance and associated requirements. However, this assessment will continue as other operational requirements permit

Contact: Gordon May (613) 990-3019
Project Number: FNVG6

TECHNICAL AND OPERATIONAL SERVICES

The Technical and Operational Services (TOS) branch conducts R&D to improve the efficiency and effectiveness of those central services provided in support to DFO Programs, by testing and evaluating communication and electronic technologies, exploring new environmental technologies, developing and implementing vessel maintenance programs and services, and human factors research to improve the safety and effectiveness of our sea-going personnel.

Research & Development Plan
Year-End Budget Summary
1999-2000

PROJECT NUMBER	PROJECT TITLE	FUND SOURCE	1999-2000 FUNDS	
			CCG	PARTNER
FNVE6	Integrated Digital Switch Investigation	CCG	147	
FQAF6	Workload Analysis - Effects of Fatigue During SAR Operations	CCG	61.6	
FQAG6	Vision - Acuity and Colour for Seagoing Personnel	CCG	.7	
FQBD6	Research, Testing & Development of Material - CCG Ship	CCG	24	
FQBK6	Hearing Standards for Seagoing Personnel	CCG	7.9	
FQBU6	Ship/Shore Data Communications	CCG	151	
FQCD6	Integrated Navigation Data Bus (Inbus) Study	CCG	51	
FQCJ6	Ship Emission Particulate Filter	CCG	40	10
FQCK6	Dynamic Engine Combustion Analysis (DECA)	CCG	70	90
FRBQ6	U.S. Ship Structures Committee	CCG	15	45
FTAC6	Automatic Identification System for VTS	CCG	260	
FTAH6	Secure Network Communications	CCG	N/R	
FTAK6	Investigation of the Enhanced Navigation Performance of GPS/GLONASS Receiver Tech.	CCG	22	
FTAM6	Communications Framework of the Future	CCG	N/R	
FTAN6	Radar Narrow-Band Processing Evaluation	CCG	0	
FTAP6	Shipboard Internet	CCG	77.4	

N/R – Nil Report

Technical and Operational Services - TOTAL	CCG	927.6	145

Integrated Digital Switch Investigation

The Canadian Coast Guard (CCG) operates a large number of operational systems that rely on digital communications networks. These digital networks interconnect equipment at CCG facilities and support CCG systems and applications. At present, networks are being reviewed and optimized in order to reduce costs, to support future CGRS/VTS amalgamation, and to support future applications (INNAV, DGPS, DSC).

Today, most switching platforms within industry whether public or private are based on digital technology. Digital switching platforms are built around Digital Signal Processing (DSP) technology and embedded microprocessors as the primary engines for both call processing and services. A digital switching system using such an advanced architecture is designed to operate in a variety of telecommunications environments. In addition to solving many current interconnection problems, a digital switch will enable new applications to take advantage of the increases in speed, bandwidth and functionality. This in turn increases the efficiency and competitiveness of the organizations that implement digital switching systems. Coast Guard has a strong interest in the successful use of this technology since it offers to provide high performance solutions at low cost for CCG telecommunications requirements.

While a commercial-off-the-shelf digital switching system appears to be the logical successor to the current in-house analog switching design, a number of key issues facing its implementation remain to be resolved. These key issues include:

- The integration of a digital switching system with existing equipment and applications;
- The cost of implementing a digital switching system;
- The capabilities it offers over other technologies; and
- The changes required in current applications in order to implement the digital switching system.

These issues are relevant to future Coast Guard networks, systems and applications. At this time, CCG is implementing CCGNet, DSC, CCS, INNAV and reviewing the infrastructure that these important operational systems will require. By addressing these issues now, CCG will be able to invest wisely in new technology and position itself to utilize, in future, the most cost effective digital technology.

This year's efforts included: the review of the CCG requirements and current CCS technical specifications; the investigation of the current state of digital switching standards followed by a market survey to determine availability and cost of this technology; the cost benefits analysis of implementing a digital switching platform and implementing a test facility and demonstration of the feasibility of integrating such a switching technology with the current national CCS system.

The next step the CCG will undertake is to conduct the required activities in support of software/hardware integration and testing of a digital switching platform with the current CCG communications and control system including updates to the system documentation.

Contact: Marcel Bouliane (613) 998-1533
Project Number: FNVE6

Workload Analysis – Effects of Fatigue During SAR Operations

Since 1995, the Marine Technical and Operational Directorate (TOSD) has focused some its R&D initiatives in the area of Shipboard Human Factors and Employee Fatigue. Initial research focused on the area of Shipboard Watch Scheduling. Work since 1996/7 has examined the effects of a 42-day "on-duty" cycle aboard The Canadian Coast Guard (CCG) vessels operating in the Arctic.

This research examined the impact on Shipboard Watchkeepers level of fatigue, alertness, sleep, cognitive performance and socio-psychological well-being during an extended crewing period (i.e. 42 days), while working 12 hours per day. At the same time, the effects of different Watch Schedules were examined to determine if any watch system had advantages and/or disadvantages over another. It was apparent that more research on the issue of fatigue in CCG operations was required.

Phase 1 of the CCG Lifeboat Fatigue Study has been completed and involved a comprehensive review of the operational requirements of CCG lifeboat personnel and the impact that fatigue may have on their safety and performance. Recommendations and guidelines for the research methodology to be used in determining endurance limits to CCG lifeboat personnel has been included in the final report.

A CCG working group has been established prior to proceeding with the next phase of this multi-year study.

Contact: Philip Murdock (613) 998-1630
Project Number: FQAF6

Vision – Acuity and Colour For Seagoing Personnel

Much work has been carried out by the Canadian Coast Guard (CCG) in the development of standards for static visual acuity in seagoing occupations. Most recently, research has been conducted to assess the requirement for peripheral vision and depth perception for seagoing occupations. The draft research report was provided in the summer of 1998. The document is being reviewed for final acceptance.

It is crucial that occupational requirements be based on actual, job specific requirements, if one wants to ascertain their true validity. The first phases of the research which were conducted on visual acuity and colour vision were mainly conducted in a laboratory environment using test subjects taken from the field (pictures of buoys, dials, charts, etc.) The experience leamed from this first phase was that greater emphasis has to be placed on developing tests which more closely resemble the tasks performed in the field. A further review of the first phases was carried out to assess the research in terms of defendability. All agree that a complete task analysis must be carried out to determine what the actual requirements of the job are as they relate to colour vision and visual acuity.

For this year, the CCG with the Transportation Development Centre (TDC) had completed the proposal and statement of work however the CCG has since been approached by Conservation and Protection (C&P) to co-partner on this project. With the final work description having to be approved by all parties (CCG, C&P, TDC), along with the lack of internal resources to manage this year's project, work will now begin next year (2000-2001).

Contact: Sharon Robertson (613) 990-2573
Project Number: FQAG6

Research, Testing & Development of Materiel – CCG Ship

Changes in manning levels, lifestyles, technology and logistics standards have, combined with a greater awareness of safety and environmental issues, required the CCG Fleet to consider the use of new products and equipment to improve the quality of life aboard ships, to provide work saving opportunities and to promote a more positive impact on the environment.

On a continuing basis, as recommended by seagoing personnel, departmental experts and external specialists, Logistics Services (AWTF-C) will research, develop or purchase marine oriented equipment and products for trial board CCG ships. The results of the trials will be analyzed by AWTF-C and those items that prove satisfactory will be promoted for use throughout the CCG Fleet. The following describes the three areas of concentration for this year's project.

CCGS ANN HARVEY - A new type of cooking equipment, a RoFry cooker, was purchased at a cost of $10.5K and installed aboard the ship in March 2000. The Newfoundland Region requested the cooker, following national consultation on potential R&D projects. The main reason for testing this type of cooker was that it could potentially replace the use of the deep fat fryer and produce healthier dishes. The cooker can cook parboiled foodstuffs such as french fries, chicken wings, etc., without using oil. In the evaluation report received in July 2000 from the Commanding Officer, the concept is highly recommended as too much deep fried food is being served aboard most CCG ships. Some good results were achieved. However, given the limited cooking capacity (size) of the equipment, the time required to clean it and problems with the catch tray inside causing a burn taste on products after multiple uses, it was recommended to follow up with the manufacturer to try to alleviate these problems. As it stands now, the RoFry cooker is deemed impractical for use on this ship.

CCGS TRACY - A multipurpose small type of combination oven/steamer (Alto-Shaam), new on the market and marine adapted, was purchases at a cost of $8.5K in February 2000 and was to be installed aboard the ship shortly after. The Laurentian Region requested the equipment, following national consultation on potential R&D projects. The main reasons for testing this type of equipment were its versatility and cooking speed. As this one piece of equipment can broil, steam, bake and roast, it also saves space and helps reduce oven hood length requirements. However, due to various reasons, including lay-up and refit periods, the equipment has not been installed yet and should be installed during the fall 2000.

CCGS SAMUEL RISLEY - Fitness equipment (a treadmill) was purchases at a cost of $$5K and installed aboard the ship in February 2000. The Central & Arctic Region requested the equipment, following national consultation on potential R&D projects. The main reasons for testing the treadmill was to test equipment that is not currently included in the national standard (scale) for fitness equipment. The acquisition of the treadmill was strongly recommended by the Commanding Officer. The evaluation report received from the ship in mid-June 2000 indicated that the treadmill is by far the most used and appreciated piece of exercise equipment.

Contact: Louis Asselin (613) 990-3091
Project Number: FQBD6

Hearing Standards for Seagoing Personnel

This project is one specific component in an umbrella study by Fleet Systems addressing fitness and medical standards for physically demanding jobs of seagoing personnel.

The work of the Canadian Coast Guard (CCG) Ship's officers and ship's crew is frequently carried out in areas where high background noise levels are constant, and/or in conditions where they are exposed to harsh environmental conditions, such as extreme wind, cold, rain and fog. For the safe and efficient operation of the vessel and the vessel's program, it is extremely important that what needs to be heard, is, in fact, heard. For example, they must accurately distinguish the direction sounds such as the location of a bell or whistle buoy and must be able to hear and recognize normal/abnormal variations in machinery sounds. It is for this reason that both Health Canada and CCG are in the process of reviewing and revising their medical standards for seagoing operations.

The CCG as the employer is responsible for demonstrating the bona-fide occupational requirements for the medical standards as set by these organizations. Collection of research scientific data specific to fleet operations will ensure that a safe standard will be set so that what needs to be heard for the safe and efficient conduct of the operations, is heard. The research to be conducted on this subject will also assist in research to be carried out for other occupations who are looking at addressing their hearing standards. In assessing the human factor (hearing) the level of efficiency and effectiveness in the delivery of fleet programs can thus be improved.

Included in this research is the need to assess the reliability of hearing aids. As the employer, there is a requirement to accommodate individuals. Hearing aids are considered by some to be an acceptable method of accommodation and one which should be allowed within the medical standard. The question raised is the issue of the reliability of hearing aids in the environment in which seagoing personnel live and work, as well as in the work performed. Hearing aids will be looked at in this context.

A final report for Phase 1 of the Hearing Standards for Seagoing Personnel was presented with the consensus of the project management team being the product was acceptable, but to be more clearly understood, the document required further refinement and clarification. The problem areas were identified to the contractor and agreement was reached between the parties. Over the next several months, the recommended changes have been made and reviewed. A final review of the document by interested parties is being done prior to official acceptance of the report.

The final outcome from the research carried out by BCRI was the establishment of a 'fence'. Meaning, if an individual meets the standards set through the audiogram, nothing further is required. If however, he/she does not meet the fence, the individual will need to be tested further in the area of localization, speech perception, alarms and signal detection.

Further R&D work is needed to ensure *that the minimum medical standard for hearing is appropriate for the tasks required, and that it is defendable.*

Contact: Joanne Jankun (613) 993-8024
Project Number: FQBK6

Ship/Shore Data Communications

The Canadian Coast Guard's (CCG) long term goal is to implement and operate a highly integrated, diversified and dynamic data communication system connecting existing ship and shore based networks and satisfying a broad range of requirements including digital voice, e-mail, image transfer, and fleet position reporting. The use of multiple radio frequencies wireless networks, SATCOM network, land

line and digital channels (PSTN/PSDN) are included in this goal. The increased use of MSAT and future technological changes will also be taken into consideration.

Based on the recommendations in the Technology Assessment (TA) report (Ship/Shore Communications Server System (CSS), Document No. 1205-007-D002), the project concentrated this year on research into the Universal Wireless Ship Shore Email system which would be used throughout the CCG fleet. The ultimate objective is to have a common e-mail system for all ships and all regions.

The R&D efforts were directed towards a development of a common set of requirements for Operational Email, evaluating various commercially available versions of marine email packages and towards implementing a prototype for a small number of ships.

The following was achieved:

- A set of Requirements for Wireless Operational Email suitable for ships was produced.
- A Functional Specification for operational message notification services was developed. Such services would extend E-Mail Server's communications capabilities to include initiating the delivery of messages to a variety of remote clients computing devices on board of ships and elsewhere.
- A detailed System Specification was developed for an e-mail system satisfying the Functional Specification.
- Compatibility of the current implementation of FLAG II (a vessel position reporting system) with the proposed e-mail system was verified. This was to assure that existing MSAT satellite transceivers could be shared by both systems.

Contact: Michal Hallen (613) 998-1136
Project Number: FQCD6

Integrated Navigation Data Bus (Inbus) Study

Ship electronic navigation systems have become more interdependent due to signal digitization. This enables the manipulation of signals and the generation of intelligent data which can be shared with other systems. Due to this interdependence, the need is recognized to plan and manage the manipulation of data between electronic systems aboard vessels.

With the CCG Fleet becoming multi-tasked, there exists a requirement for navigational data to be available to different disciplines at different times and in different locations.

The Integrated Navigation Data Bus (Inbus) Project, implemented in separate phases as outlined below, was installed and tested aboard the CCGS Leonard Cowley in St. John's Newfoundland.

The pilot project successfully produced and demonstrated a compact, scalable, low cost system that will provide connectivity between shipboard navigational sensors and display instrument, eliminating point-to-point wiring.

Implementation

- Conduct a Requirement Definition Phase.
- Market Survey & develop a generic Data Bus Specification.
- Prototype Data Bus Design & prepare Test Implementation Plan.
- Conduct prototype Data Bus system tests.

The Requirement Definition study was carried out as per the Statement of Work (SOW), and the Shipboard Navigation Data Bus (SNDB) Requirements Specification was developed and the SOW for the next phase was delivered to CCG.

Following completion of the initial phase, a market survey was carried out to assess P&A and vendor's product applicability to produce a generic Data Bus Specification, and a SOW for the next phase. The SNDB Progress Report which outlined the progress to-date regarding the survey of COTS product was submitted to CCG in March 1997. Request for Proposal (RFP) package was developed to produce a prototype SNDB system in the fall of 1997.

RFP was issued and the process was initiated in February 1998 for the design, development, and testing of the Network Interface Unit (NIUs), which was the key component for the SNDB system. Subsequently, the contract was awarded to Compusult Ltd., of Mount Pearl

Newfoundland. Following the issuance of the contract, Compusult Ltd. successfully developed the NIUs, and procured fibre optic Ethernet network switch, MAU transceivers for the NIUs and the network management computer. The SNDB system was setup, bench tested, and enhancements made to correct the design deficiencies. Upon successful bench test, the SNDB system was transferred from Compusult Ltd. to St. John's CG Base for the sea trial.

The SNDB system was installed in February 1999 aboard the CCGS Leonard Cowley in St. John's Newfoundland to sea trial the prototype, SNDB system, in an operational environment. During the initial sea trial, a number of technical problems were experienced, and the prototype, SNDB system was returned to the Contractor for repair and modification. Lessons learned from the first sea trial were applied to the system and the SNDB system was re-installed with the addition of the Remote Alarm Monitor Panel.

The final sea trial was carried out in February 2000, and the SNDB system performed flawlessly and provided correct navigation data from all sensors to the respective instrument aboard the CCGS Cowley. The SNDB project has successfully produced and demonstrated a compact, scalable, low cost system that will provide connectivity between the shipboard navigational sensors and the display instrumentation, eliminating point-to-point wiring.

Contact: Ronnie Yamamoto (613) 998-1542
Project Number: FQCD6

Ship Emission Particulate Filter

Marine vessels as all other mobile sources that are powered by the combustion of fossil fuels, emit pollution that is harmful to the environment. Though the quantity of marine vessel emissions is small compared to that from other sources as road transportation, the impact can be larger under local conditions. For example, the 8000 annual vessel movements in the Vancouver air shed is considered to be a large contributor to the levels of oxides of nitrogen in the Lower Fraser Valley.

The International Maritime Organization is pursuing the implementation of regulations for marine vessels and has to date established a level of 5.0gm/kw-hr for NOx. Marine engine manufacturers and companies involved in aftermarket emissions control technologies have been developing technologies in an effort to meet the IMO existing regulations and location specific regulations as established by some States in the US with coastlines. Both exhaust emission reduction solutions are in many cases cost prohibitive and with respective to the engine manufacturers relate to new engines.

A collaborative R&D project was conducted between CCG and Environment Canada to investigate the development of a cost effective exhaust emissions control technology for marine diesel engines (propulsion and auxiliary). The result of the project was the design, fabrication and testing of a modulaire, cost effective particulate trap. The technology was 'bench' tested using a 750 Hp Caterpillar engine. The objective was to determine the impact of the 'trap' on the exhaust emissions from the diesel engine under operating conditions similar to a medium speed marine diesel propulsion engine. The testing resulted in the following:

- The 'trap' did not affect the engine fuel consumption
- Particulate mass was reduced by 16% with +300 ppm sulfur content diesel fuel
- Oxides of nitrogen were reduced by 22%
- 'trap' design was cost effective at an estimated vaue of $4000

The technology did not meet the expected results of up to 40% reduction in particulate mass, though similar results were obtained from smaller systems based on the same design. Further development would be required to achieve the particulate reductions.

Contact: Shakil Ahmed (613) 998-1784
Project Number: FQCJ6

Dynamic Engine Combustion Analysis (DECA)

In the early 1980s, The Canadian Coast Guard (CCG) recognized the need to re-engineer it's maintenance effort for the fleet. In the face of cost-cutting programs and staff reductions, a new approach was needed to institute a total maintenance management model. The development and implementation of computerized maintenance management systems in the fleet was seen as the backbone of any maintenance effort and, with the breakthrough of open system architecture and connectivity, the user could be allowed to integrate third

party systems such as CAD, graphics viewers and predictive maintenance technologies. Predictive maintenance (as an extension of preventative maintenance) is the final piece of the total maintenance managment model. The theory is that equipment is performing at peak efficiency when performance parameters such as vibration, temperature, pressure, speed and alignment fall within a certain band width. As the equipment wears, measurements drift beyond established control limits and maintenance is required. By tracking and analysing these parameters, equipment degradation can be trended and it's ultimate failure can be predicted, avoiding costly down time and emergency repair. Conversely, when measurements indicate equipment is operating efficiently, a case can be made to avoid costly time-based maintenance.

With this project, the application of predictive maintenance was advanced one step further. The CCG and industry have already embraced the advanced maintenance techniques such as vibration and lubricating oil analysis and trending as cost effective means. It has been recognized for decades within the field of marine engineering that one of the best indicators of diesel engine performance is that of the cylinder pressure displayed as a function of cylinder volume during the combustion process. From this curve many parameters can be calculated, including the work done per cylinder.

Historically, peak cylinder pressures in large, slow-speed engines could be measured using pressure gauges with integrated check valves and engine indicators were used to plot P-V curves for one or more cycles. These plots became known as indicator diagrams or indicator cards. The indicators themselves were mechanical devices consisting of springs, levers, camshafts and a chart recorder arrangement with pen and paper on a rolling drum. While useful for slow-speed engines (140-200 RPM), their accuracy was suspect and they did not reveal the whole story of the combustion process. As well, the owner/operator of the four-stroke, medium-speed diesel (400-1200 RPM) had to rely on simple periodic measurements of peak firing pressures; again, an incomplete picture. The bulk of the Coast Guard fleet which consume the most fuel and produce the highest emissions, is comprised of these four-stroke, medium speed diesel engines.

Recent developments of fast acting pressure transducers have now allowed on-line combustion analysis techniques to be improved and used on these higher speed applications . The most common types of pressure transducers used are resistive (strain-gauge), capacitive, piezoelectric and fibre-optical. The previously approved joint 98/99 R&D and PERD projects HTAC6 and FTAJ6 for the Firing Pressure Remote Transmitter on board the CCGS Tanu have used the fibre optic transducers with qualified success to accurately project cylinder pressure versus crankshaft angle data to the user in a friendly format for the purposes desribed above.

The DECA project's goal for 1999-2000 was to implement a second generation Firing Pressure Remote Transmitter (FPRT) aboard the G.R. Pearkes, a Type 1100 Icebreaker based on a conceptual design for performance analysis of ship's machinery. The main objective is to realize the benefits of performance analysis for diesel engine balancing, maintenance of peak operating efficiency and reduced operating costs.

Accomplishments include the development of a second-generation system that can accommodate 60 input channels, deal with four-stroke designs, analyze turbo machinery, sample, buffer and filter to detect miniscule changes in engine output. The design changes also enable hand-held display technology for engine balance on-line. Existing sensors were reused where-ever possible (exhaust gas temperature, KW output, etc.) and an interfacing strategy was implemented that ensured isolation of the FPRT from other ship sub-systems along with electrical signal calibration flexibility.

Results to date indicate the longevity of the pressure transducer is a barrier to wider application.

Notwithstanding, the design drawings for the complete 52 channel implementation and the hardware including enclosures, new sensors, board sets and display system were done during this year's project. As of March 31,2000, installation design, data acquisition system development and interfacing development completed. Ship install planned for June, 2000. Display and analysis software to be factory tested before ship installation.

Contact: Ian Campbell (613) 990-0655
Project Number: FQCK6

U.S. Ship Structures Committee

The United States Ship Structure Committee (US SSC) is an international, multi-agency with the mandate to further research and develop in the area of ship structures. The purpose of the committee is to prosecute a research program to improve the hull structures of ships and other marine structures by an extension of knowledge pertaining to the design, materials and methods of construction. Canadian membership is comprised of the Defense Research Establishment Atlantic (DREA) (Canadian Navy) and Transport Canada (TC).

The Canadian Coast Guard (CCG) Fleet branch has actively participated in SSC projects under the auspices of Transport Canada since 1991. The purpose of this project was to provide CCG personnel/technical experts the opportunity to attend and participate in technical sub-committee program planning meetings and selected project technical committees.

Contact: Justus Benckhuysen (613) 998-1496
Project Number: FRBQ6

Automatic Identification System for VTS

Automatic Identification System (AIS), is a new technology that remotely tracks and monitors vessel movements and status. With AIS the vessel is responsible for generating navigation (position, speed, course, etc.) and other status information and reporting this information automatically to a surveillance centre, typically a VTS centre, and/or other ships. The centre may periodically poll participating vessels via a communications link and the vessels will respond over the same link. The polling and response sequences will be fully automatic. The centre will have suitable processing and display equipment to acquire and present the vessel tracking information.

AIS has particular application to vessel traffic services (VTS). In combination with other methods of vessel tracking such as Radar and DF it has the potential to greatly improve the functionality and cost performance of current VTS systems. Under certain conditions AIS has the capability to actually replace shore-based VTS radar.

AIS equipment has been purchased from various manufacturers during the past four fiscal years to evaluate the techniques used. In addition to the AIS equipment purchased for trial on the West Coast from 1994/95 R&D funds, additional equipment was obtained in 1995/96 for another trial on the St. Lawrence River between Montréal and Québec. This trial was a co-operative venture among the Canadian Coast Guard (CCG), the Canadian Hydrographic Services and the marine industry represented by the Canadian Shipowners Association and the Shipping Federation of Canada who are members of the Marine Advisory Board.

The adoption of AIS as a universal worldwide system has made significant progress in 1998 when IMO formally adopted the Operational Performance Standards for a Universal AIS and when shortly thereafter the ITU formally adopted corresponding Technical Standards for a Universal AIS System using Time Division Multiple Access techniques.

Currently a new generation of low orbiting satellite systems is being deployed, i.e. OrbComm, Irridium, GlobalStar, and soon Teledesic. This will revolutionise global voice, paging, and fax, and bring mobile internet and video to ships. The AIS systems may also be affected by these developments particularly in the area of long range applications. There is therefore a need to expand the concept of AIS to include these developments.

This year's project concentrated on research into the future AIS. The following subjects were pursued:

- Expansion of AIS technologies to include smaller vessels
- Increasing availability / reliability of AIS systems
- Impact of termination of Selective Availability of GPS by the US Air Force.
- Evaluation of new sub $1000 satellite based transponders
- Integration of AIS and ECDIS (Electronic Chart Display Information System)
- Role of public entities in tracking mobile objects, primarily the confidentiality of information and its reliability/accuracy.
- Suitable recommendations and standards for the future use of AIS in Canada and Internationally
- Developing Policy for Canadian Government towards AIS

A comprehensive report was produced: Mobile Object Tracking: Technology Overview

A satellite transponder DMR 100+ by Skywave Technologies was purchased for field evaluation. The technology is being used to track shrimp fishing boats off Digby, NS.

A significant amount of effort was spent supporting the Halifax Harbour Renewal Project. Specifically, CCG/HQ implemented an equipment contract with ICAN Ltd. for the supply of 4 AIS transponders, 1 portable AIS transponder and 2 AIS base stations plus associated system software, manuals, and training. CCG/Maritime Region has installed the equipment. The system is now operational. A prescribed test period will follow. This test program will focus on the operational application of AIS and afford mariners and CCG personnel an opportunity

for hands-on work. CCG/HQ wrote a high level test program document that will be developed by regional project staff into a detailed procedural document. The Halifax AIS project will be the first implementation of the Universal AIS in Canadian waters.

Contact: Michal Hallen (613) 998-1136
Project Number: FTAC6

Secure Network Communications

The Canadian Coast Guard (CCG) operates a large number of operational systems that rely on computers and analog or digital communications networks for the processing and communication of vital data and information in the course of daily business. There is a need to protect the computer systems, related communication networks and the data and information they handle. At present, these networks are being reviewed and optimized in order to reduce costs, to support future CGRS/VTS amalgamation into MCTS, address DFO/CCG fleet amalgamation needs and to support applications and systems such as INNAV, DGPS, DSC, Ship/Shore communications, SARCOM.

Historically, secure communications were primarily linked with the passage of classified or protected information using voice, facsimile, TELEX or other similar data transmissions over wire or radio circuits. The data transmitted was protected by one or more levels of physical access protection and encryption provided by both manual or automated data encryption systems inserted into the communications path. The use of existing STU III encryption devices to protect voice and facsimile transmissions over telephone wire or radio circuits is a typical example.

With the proliferation of computers which provide alternative communications access paths like Email and the Internet, the historical solutions are not readily applicable to the protection of classified or vital information. The computer and its communications networks has become an indispensable tool for performing day to day work, an essential communications mechanism and a primary repository for decision making data and information. This has developed a critical dependency and vulnerability within DFO/CCG on the availability of and access to our computer systems and the information they contain. The protection issue is raised beyond the need to secure classified information by the additional need to secure both information and systems vital to the conduct of daily business that is not security classified in nature. This protection must be implemented without unduly imposing on the ability of the user to either obtain essential information or to communicate that information to other authorized users. Any solution implemented must be standardized in order to ensure security established does not impede authorized information access and communications.

No report was submitted for this year. Please direct all inquiries to the undersigned.

Contact: A.L. Mennie (613) 998-1551
Project Number: FTAH6

Investigation of the Enhanced Navigation Performance of GPS/GLONASS

The accuracy and availability of a GPS position fix is determined by the number of satellites in view and their geometry. A typical Differential GPS (DGPS) user with no surrounding obstructions achieves an accuracy of 10 metres 95% of the time throughout the coverage area using between 6 and 11 visible satellites. In some constricted waterways, surrounding terrain can mask some of the available satellites reducing the accuracy and availability of the DGPS position fix.

Receivers that use both GPS and GLONASS satellites have between 15 and 18 satellites above the horizon. This large number of satellites mitigates the effects of signal masking in constricted waters and increases the accuracy and availability of position fixes. This impacts on safety through reduced collision risk. It also increases the probability of accurate buoy positioning when using GPS/GLONASS.

The project was intended to analyze the availability, accuracy and reliability benefits of using differential GPS augmented with GLONASS and Differential GLONASSS (DGLONASS) for marine navigation.

Because of the limited number of satellites of GLONASS due to the economic condition of the USSR, this part of the project was not performed. Instead, testing of a Multi-Reference Station approach was done. The budget variance for this project resulted from it not being practical from an informative viewpoint to complete deliverables #1 and #2 and partial #3, pertaining to GLONASS.

In its revised format, this Project investigated the impact of an active ionosphere on ambiguity resolution using a multi-reference station approach and answered questions which could not be answered during a first series of tests carried out previously at the University of Calgary.

Data collection for analyses came from Grand-Mere, Sorel, Thetford Mines, Deschillions, Trois-Rivieres, Lauzon and Acadie at times when there was high levels of ionospheric activity.

The experiments demonstrated the advantages of the NetAdjust multi-reference station approach over the single-reference station approach to resolve integer ambiguities more effectively and to improve accuracy performance to 10 cm, a highly desirable accuracy level for the vertical component for hydrographic operations and navigation in constricted navigation channels.

Also, the use of real ambiguities in the multi-reference approach, which is operationally more robust than that of integer ambiguities, was shown to still deliver a level of accuracy superior to 10 cm. This position accuracy improvement is more pronounced from the height perspective. This subdecimetre 3 D accuracy will be useful in hydrography and water depth information used in precise navigation.

This project was considered completed as of March 31, 2000.

Contact: Sun Wee (613) 998-1514
Project Number FTAK6

Communications Framework of the Future

The objective of this R&D proposal was to prepare a comprehensive review of technical communication needs for the Canadian Coast Guard (CCG) and for marine industry, and to define the technical options to meet those needs.

The world of communications is driven today by dropping prices, increased demand for fixed and mobile services, easier access to data bases, and the need to communicate directly with many and diverse parties. New technologies are being rolled out which meet these needs. There is a need to study the impact of these technologies on the CCG organization, since it supports a distributed mobile workforce over a large area, and on the CCG clients who expect to receive communication services.

The CCG's communications infrastructure, which includes a network of over 130 peripheral communication transmitter sites interconnected with a national network of over 350 vessels connected by radio and landlines, will need to adapt to change in order to remain effective and efficient. New services or updated services offered in new formats will be required. Additionally, shipboard communications has become more complex, while at the same time the level of crewing has been reduced. Thus the fewer number of users must do more duties including communications and thus more simplified user interfaces are required.

No report was submitted for this year. For further inquiries, please contact the undersigned.

Contact: Pieter Leenhouts (613) 998-1539
Project Number: FTAM6

Radar Narrow-Band Processing Evaluation

Most present radar systems operated by the Canadian Coast Guard (CCG) transmit the signals from the radar site to the operations centre over wide-band telecommunication links such as microwave radio systems. These are costly to purchase or to rent. Significant cost savings can be realized if these radar signals were processed in such a manner that they could be transmitted over standard telephone lines at speeds not higher than 56Kb/s.

At present, several companies are offering narrow-band radar signal processing equipment. These companies, however, generally do not provide comprehensive reports that characterize the performance of their equipment under all operating conditions such as the severe sea clutter or ice conditions which are often encountered in Canadian waters. While the CCG did undertake one major screening of available equipment with the narrow focus to specify interfaces to the INNAV system; there is no systematic evaluation process available that can be

used routinely. Consequently, the CCG has had to limit the application of narrow-band systems to geographical areas where the expected conditions could safely be classified as benign.

New systems appear on the market at regular intervals. This was the case recently when Maritime Information Systems MARIS won a contract in Norway against Norcontrol, which has been our major supplier to-date. We have not been able to evaluate this system. Other systems were put into Vancouver which now are rated as marginal. Norcontrol and Sofrolog, a new player in this field, are offering new developments in this field which should be evaluated against a quantitative standard.

To assist the qualitative evaluation of narrow-band radar processing equipment on the market, it was desirable for CCG to have a test-bed capable of recording and playing back live radar data for testing the equipment. The CCG determined that it was appropriate to purchase and install at an existing VTS site, the additional elements necessary to evaluate the performance and life cycle costs of narrow-band radar processing equipment.

Sigma Engineering provided an unsolicited proposal to build the test-bed in October 1999 and CCG found it acceptable with some modification. It was identified that Sigma Engineering Ltd. was the sole source that had the technical ability to build the test-bed with the budget of $85k within the fiscal year, because it had been manufacturing systems for radar recording and playback for many years. Prior to awarding the contract to build the test-bed, CCG issued a tasking to Sigma Engineering in November 1999 for developing the details of the specification and application configuration for the test-bed at a cost of $5.5 K.

CCG later received the draft report for the tasking from Sigma Engineering Ltd., but found the report unacceptable. Sigma Engineering Ltd. also informed CCG that it would not be able to complete the test-bed development within the fiscal year and suggested re-scheduling the completion date. CCG decided to cancel the project as the contractor could not deliver all project deliverables by March 31st deadline due to lack of resources.

Contact: Bert Tepper (613) 998-1548
Project Number: FTAN6

Shipboard Internet

This project evaluates the technology and techniques related to the connection of internet access to shipboard computers on DFO/CCG vessels at a cost and with performance simillar to that available in any office. Currently DFO/CCG vessels do not have an equivalent capability available to them while either in port or at sea. The objective of the project was to investigate the capability of existing communication mediums to effectively supply Internet access for vessels. Vessels at sea have only one method of higher speed access and that is with Std B Inmarsat and only the larger vessels have this equipment installed. This high speed is a lowly 64Kbts and equates to a shore-side telephone modem, however the shipboard cost is around $10US per minute.

The CCG National Working Group for Ship Data had discussed this problem in the past and had decided a full Internet access was not possible due to the extremely high cost. What was decided was that a system for passing email without large attachments was possible at an acceptable cost. Out of the research was born the system now referred to as SHIP NET. SHIP NET is a batched e-mail system that has been deployed on CCGS Louis S. ST. Laurent, CCGS Terry Fox, CCGS Radisson and CCGS DesGroseilliers. The Ship Net systems retains all emails aboard the vessel communications server and sends them ashore three times a day at pre-determined off peak hours. It also picks up any messages destined to the vessel at this time. The messages destined for the vessel is stored on a shore based communications server and are forwarded to the ship when the ship calls in to send its messages. Those message destined for DFO addresses are then routed to the DFO LAN and all other are sent via Internet. This system has proven successful for routine messages that have no urgency attached to them and for personal emails for the ship's crew.

Laurentian region has taken the Ship Net system one step further for the winter sailing season. The ship uses a RAS in system the sends and receives batched e-mail. Upon disconnect, the respective servers distribute the mail to the final destinations.

The in-port Internet solution was found using Spread Spectrum Radio, in particular the Hopper, made by the Wi-lan Corporation of Calgary, Alberta. This unit has been in CCG service in most regions for some time now, with good performance results. The Hopper uses a pseudo-random noise code to spread the RF signal over a wide bandwidth, resulting in low amplitude that is difficult to detect or jam. Frequency-hopping technology, first used for military radio, is capable of 10 Mbps, or so, bandwidth. CCG currently uses the 1.9 Mbps version of the Hopper, which is more than adequate for most communication applications.

Typical CCG port configuration involves a base system (master) serving 10 or more ship (slave) systems. The radios are connected to their respective Shore or Shipboard LAN, and providing a seamless bridge for Ethernet communications. The shore-based master polls each slave, offering time-shared two-way communications without operator intervention. The shore-based LAN will "appear" whenever the ship travels within range, 4 km using collinear omni-directional (whip) antennas. This system is presently installed on 10 vessels (3 in Central and Arctic and 7 in the Maritimes). This system will have to be extended to other vessels with the introduction of MIMS and its requirement for high data rate.

The next generation satellites called VSATS (Very Small Aperture Satellites) with data rates between 1Mbts to 2Mbts will be the next challenge for passing data to ships at sea. VSATS will perform ashore because of the stable platform. Also the large dish size (1.4M) will restrict this system to 1200's and above. The challenge will be to stabilize the [platform while reducing the dish size while maintaining the data rate.

Contact: Roger Doucett (613) 998-1523
Project Number: FTAP6

ICEBREAKING

Icebreaking Operations are those activities such as icebreaking escort, channel maintenance, flood control, harbour breakouts, ice routing and information services for marine traffic navigating through or around ice-covered waters, and for the general public. It also coordinates the movement of cargo for the annual re-supply of Northern settlements and military sites using contracted commercial carriers.

R&D projects are designed to stay abreast of those technologies necessary to deliver an effective service, thereby enhancing the safety of winter navigation and providing support to the economy and to general marine safety.

Research & Development Plan
Year-End Budget Summary
1999-2000

PROJECT CODE	PROJECT TITLE	FUND SOURCE	1999/2000 FUNDS	
			CCG	PARTNER
FQAR6	Acoustic Sensing of Ice Pressure Conditions	CCG	0	
FTPA6	Cross-Polarized Radar Trials	CCG	48.3	

Icebreaking – TOTAL	CCG	48.3	

Acoustic Sensing of Ice Pressure Conditions

Every year from mid February through March, the Gulf of St. Lawrence becomes predominantly ice covered. During the difficult ice years between 1990 and 1995, the Canadian Coast Guard (CCG) escorted between four and five hundred vessels in this area each year. An extremely difficult portion of the Gulf exists between Cape Ray, Newfoundland, East Point Anticosti Island and the Magdalen Islands because of its susceptibility to ice pressure events, which have brought shipping to a standstill in the past. Since the winter of 1989/90 (with the exception of the last two light ice years) there have been numerous incidents of ice pressure events which have trapped a maximum of 36 commercial vessels at one time for up to 10 consecutive days. These occurrences have presented the Coast Guard with difficult and challenging circumstances in which to manage ice routing and deploy icebreaker assistance.

The CCG is also faced with the task of monitoring the effects of the new Confederation Bridge on ice conditions in the Northumberland Strait. The foreknowledge of ice pressure in the vicinity of the bridge is of vital importance in order to avoid the possibility of commercial shipping (mainly oil tankers) being trapped by drifting ice while attempting to transit the navigation spans. We know that the effects of ice pressure on ships under escort is such that they are unable to follow in an icebreaker's track. If these same effects were to occur in the vicinity of the bridge, the resulting environmental and structural damage could be extensive.

There is presently no existing technology that will give the CCG a tool to determine the extent of an ice pressure event, or to indicate areas of less pressure. Visual or satellite imagery cannot the difference between ice that is under pressure and that which is not, or determine where or when ice pressure events will commence or begin to ease off. It was hypothesized that one method of determining if ice is under pressure is to listen to the underwater noise. Ice that is under pressure is active in the sense that it is converging on itself, forming ridges and rafts, and although this motion is too slow to be seen from the air, the action is sufficient to produce a loud and characteristic noise in the water. If this underwater noise could be detected at a number of locations in the Gulf and sent back to some central location, the areas of pressure could be identified. The Institute of Ocean Sciences (IOS) as well as the Defense Research Establishment Atlantic (DREA) have been active in the study of noise radiated by ice. The intention of this project is to assess the feasibility of exploiting the signals leading to development of a capable remote sensing operational tool in the short term (3-4 years).

Unfortunately, due to this year's lack of ice for the acoustic sensing of ice pressure, this project was not able to proceed as planned. This project will continue into the year 2000-2001.

Contact: Fiona Robertson (613) 998-1581
Project Number: FQAR6

Cross-Polarized Radar Trials

A large development effort has been directed at improving ice navigation techniques and technology over the last 15 years. In recent years, increasing environmental awareness, economic pressures to improve operational efficiency, and environmentally sensitive developments such as the Hibernia project have highlighted the demand for better and more accurate ice detection capabilities.

Cross-polarized radar has been identified as a promising ice hazard detection technology during tests done by McMaster University during the mid 1980's. Operational systems were developed and tested on board the M.V.Arctic between 1986 and 1996 with some degree of success, but limited by the processing capabilities available at the time of implementation. These systems remain costly to implement, are delicate to operate, require the interpretation of a skilled operator, and cannot reliably support operations.

A recent study, conducted on behalf of the Transportation Development Centre, has developed processing techniques to combine the two Cross-polarized radar channels and automate the multi-year ice detection process, reliably maintaining the detection performance at the limit of that technology. In addition, the study identified cost effective and simple ways of implementing that technology on existing ships, using the existing radar systems without modification, and with minimal additional hardware. These developments potentially make the Cross-polarized radar technology operationally viable for the first time.

The development of processing algorithms and data analysis have been completed. Ground truthing of the results, based on available synthetic aperture radar imagery, has been performed and low cost methods of implementing a cross-polarized radar have been defined. A low-cost fishing radar has been modified to receive the vertical component of the cross-polarized radar system. The development of an azimuth slaving controller is close to completion, and trials with the Canadian Coast Guard are scheduled for late fall 2000.

Contact: Fiona Robertson (613) 998-1581
Project Number: FTPA6

RESCUE, SAFETY AND ENVIRONMENTAL RESPONSE

The Rescue, Safety and Environmental Response (RSER) is focused on saving lives and protecting the marine environment. Through R&D, projects are destined to constantly improve the efficiency and effectiveness of their search and rescue (SAR); environmental response and boating safety services, resulting in saved time and operational costs for CCG.

Research & Development Plan
Year-End Budget Summary
1999-2000

PROJECT NUMBER	PROJECT TITLE	FUND SOURCE	1999/2000 FUNDS	
			CCG	PARTNER
FKAX6	CCG University R&D Program	CCG	17.4	
FKCA6	Development of Response Strategies for Orimulsions	CCG	66.5	
FKCD6	Coastal Zone Management Project	CCG	44	
FKCT6	Benefits of Increased Wearing of Personal Flotation Devices (PFDs)	CCG	28.5	
FKCW6	Improved Ocean Currents for CANSARP	CCG	119.2	6.85
FKCY6	Removal of Oil from Subsurface Intertidal Sediment	CCG	0	
FKDA6	Evaluation of Noise Levels from Recreational Crafts	CCG	0	
FKDC6	Mechanical Recovery of Oil in Ice Infested Waters (MORICE)	CCG	45	45
FKDD6	Enhanced Sweeping Methods	CCG	30.4	
FKDE6	Maritime Activity & Risk Mapping for SAR Planning	CCG	44	
FKDF6	Extending Offshore Temporary Storage Capacity with Emulsion Breakers	CCG	10	
FKDG6	White Paper on Future Directions for CCG Oil Spill R&D	CCG	25	
Rescue, Safety and Environmental Response (RSER) - TOTAL		CCG	330	51.85

CCG University R&D Program

This project is to encourage a mutually beneficial partnership between various Canadian Universities and the Canadian Coast Guard, utilizing academic knowledge, skills and research abilities to develop practical solutions to environmental challenges and improve search and rescue theory.

There were two separate projects being done under this program this year. The first project entitled **'Development of Methodology and Tools for CCG Lifeboat Station Location Decision-Making'** utilized a Dalhousie University GIS programming student to assist in the decision-making process for the selection of a new CCG lifeboat station location. In collaboration with Paul Kendrick (CCG) and Dr. Ron Pelot (Dalhousie University) developed a methodology and tools to aid in carrying out this process. The funding for the institution of a thirty minute, fully SAR capable vessel coverage was later realized and as a result of this work CCG Maritimes region has been well prepared to make its selections for station locations. The results can be found in Mr. Kendrick's regional report, "Bay of Fundy Lifeboat Station Final Report on Site Selection". This document is restricted until released by the Ministers office.

The project is completed, however, the actual selection process will continue. CCG Maritimes must select the optimum site for a new lifeboat station in Northumberland Strait. It is expected that this process will re-commence in fall 2000 as part of an anticipated program integrity proposal.

The second project entitled **'Risk Analysis and Risk Control Strategies for Tanker Traffic in Placentia Bay'** involved a Memorial University student in his final year of his Bachelor of Engineering program assisted in generating a quantitative risk index of potential marine oil spills in Placentia Bay which produced suggested control strategies to minimize the associated risk. This information confirms the east coast of Canada as having the most significant growth in offshore development in recent years. Exploration and drilling has shown current and future development for tanker traffic in Placentia Bay as becoming the largest oil handling port in Canada.

Contact: Naomi Katsumi (613) 993-4075
Project Number: FKCB6

Development of Response Strategies for Orimulsions

Orimulsion is a heavy residual oil product (mixture of 70% of bitumen and 30% water) that is being transported from Venezuela into Dalhousie, New Brunswick, Canada for use in power generating plants. Due to the unique properties of orimulsion, and the fact that it is transported to only one port in North America, spill response agencies have yet to develop effective recovery equipment and techniques for spilled orimulsion in the marine environment. This project reviewed and tested several response devices that could be used in an orimulsion spill.

The unique properties of orimulsion make it a difficult product to recover from the marine environment. When spilled into water, orimulsion disperses into the water column and does not float like most conventional oils. In order to remove orimulsion from the water column, the product is agitated which removes surfactant from the bitumen, thus allowing it to float. The floating bitumen presents another challenge in that its high viscosity renders most skimmers and pumps ineffective. These problems would make a spill of orimulsion very difficult to respond to in the marine environment.

In response to the growing concern of an orimulsion spill, several manufactures have proposed spill response equipment. This equipment was tested to determine their effectiveness for use in recovering orimulsion. Science Application International Canada (SAIC) developed a test plan and conducted tests on an orimulsion refloater and various recovery skimmers and analyzed and assessed their performance under various operating conditions. In addition, SAIC Canada provided engineering assistance throughout this project and prepared a final project report outlining the results of the testing.

Environment Canada and the Canadian Coast Guard in cooperation with other members from the International Working Group on Orimulsions maintain an up to date bibliography and library on the orimulsion topic.

Contact: Sergio DiFranco (613) 990-3375
Project Number: FKCA6

Coastal Zone Management Project

The CCG has been supporting the Department of Fisheries and Oceans (DFO) in the development of a detailed inventory/atlas of the coastal zone (fisheries) resources in Atlantic Canada. This project, which has proved very successful in previous years, has involved information gathering from several sources including the local fishing community, Environment Canada, DFO, CCG and other agencies. The inventory consists of coastal zone maps at the 1:10,000 scale in both electronic and hardcopy forms.

This year's Coastal Zone Mapping - Maritime MapInfo Interface (CZM-MMI) project deals with the various Coastline Sensitivity Mapping projects created for the CCG over the last couple of years. This interface has been created to make various maps that CCG has either licenses for, or owns outright, but are geared towards most end users who do not understand how to use this software.
This interface is designed to make the use of these data sets easier by using dialog boxes and push buttons. The end user would require the basic MapInfo knowledge to understand how to use this interface. A Help file has been customized and focuses on all the various aspects of the CZM-MMI project.

As well, a separate interface similar to CZM-MMI has been built, however instead of the coastline sensitivity mapping, the National Topographic Series (NTS) maps that the CCG already owns, have been used. This interface has been called the National Topographic Series - MapInfo Interface (NTS-MI). Once again, it is designed with its own help file and is used in the same fashion as the CZM-MMI project.

Contact: Naomi Katsumi (613) 993-4075
Project Number: FKCD6

Benefits of Increased Wearing of Personal Flotation Devices (PFDs)

The main objective of this multi-year project is to research those critical factors essential to develop and implement strategies to more effectively target subgroups of boaters to support increased wearing of PFDs.

It has been determined that major qualitative fieldwork, through public opinion research, is required to determine boaters attitudes towards PFD wear. A national survey will assist Office of Boating Safety in understanding the attitudes to PFD use of specific boater subgroups as they arise naturally in the Canadian population.

Phase II of this multi-year project involved consulting with behavioral change professionals to determine plan for major qualitative fieldwork to conduct a comprehensive public opinion research survey to determine boater attitudes towards PFD wear. The survey methodology and questionnaire were developed this fiscal year. Eventually, these survey results will be used to assist the Office of Boating Safety in the design and delivery of interventions and the development of target-specific communications strategies to increase wearing of PFDs through motivational factors. Also the survey will provide benchmark data on which to base assessments of the effectiveness of future PFD campaigns. This research and resulting intervention strategies will establish Canada as an international leader in this area.

Due to unforeseen internal circumstances the attitudinal survey was delayed for 1999-2000 and may be conducted in 2000-2001 fiscal year. In the current year, behavioral observations were substituted.

Also, in 1999, regional staff of OBS in Newfoundland visited the USCG's OBS in Washington DC. The trip was successful in establishing links and contacts within the USCG that will assist the OBS in working towards a partnership that is mutually advantageous for both organizations.

Contact: Sharon Sellars (709) 772-2079
Project Number: FKCT6

Improved Ocean Currents for CANSARP

The basic processing of the data from the field trials has been completed and is presently being used to test and validate the model forecasts. The hydrographic data show strong baroclinicity in both drifter deployment sites: (47°N, 61°W) off the west coast of Cape Breton

and (47°N, 60°W) in the Cabot Strait area. These features will have to be accounted in the model current estimates. Furthermore, the two bottom pressure gauges spanning the first deployment site indicate significant variations in the strength of the barotropic flow in this area. Finally, selected acoustic doppler current profile data from the shipboard ADCP (e.g. the near-surface [11m] currents in Figure 1) have been processed using the CODAS analysis package obtained from the University of Hawaii's oceanography group. These 3-D, time-dependent currents will be used to carefully evaluate and constrain the model fields.

We can also report significant progress in the development of the coastal ocean forecast system model for CANSARP. All milestones for year two have been met and even exceeded in some areas. The model developed is now based on a fully prognostic three-dimensional non-linear ocean model that provides daily 48 hour forecasts of the surface currents for the Scotian Shelf and the Gulf of Saint Lawrence. The model includes tides and baroclinic effects that significantly improved quality of the predictions. The model was successfully tested during field trials in November and December. The forecast system ran in real time without significant problems and provided daily forecasts of surface currents. An example of the observed and predicted drifter trajectory is shown in Figure 2.

Initial analysis of the model performance suggests that there is still room for improvement. We are currently working and will continue to work in year three on the analysis and interpretation of model predictions for various variables (e.g. temperature, currents, trajectories). This should enable us to better understand the discrepancies between the model and the data and tune the dynamical model accordingly. Hence, the next version of the forecast system will incorporate the results obtained during field trials in November and December of 1999 and hopefully result in improved predictions for future trials.

The question of including model forecasts into CANSARP system remains to be discussed.

Contact: Peter Smith (902) 426-3474
Project Number: FKCW6

Removal of Oil from Subsurface Intertidal Sediments

The Canadian Coast Guard (CCG) Environmental Response (ER) has decided that for fiscal year 1999/2000, all R&D projects that are operational in nature and related to the recovery of pollution from the marine environment, would be of higher priority than those projects that were not (i.e. projects that conducted biological or chemical studies). Since the "Oil Removal from Subsurface Intertidal Sediments" project did not meet this criteria, it was decided that this project was not the highest priority and therefore was not pursued further.

Contact: Sergio DiFranco (613) 990-3375
Project Number: FKCA6

Evaluation of Noise Levels from Recreational Crafts

Personal Watercraft and other high powered pleasure boats have been identified as the primary source of "excessive noise" and with that an increasing number of complaints from across Canada have been put forth due this noise pollution. Also, the recent proliferation of personal watercraft, and technological advances (higher power to weight ratio engines), in engines typically employed by recreational boaters has occurred in concert with this complaints.

Due to the lack of sufficient internal resources to help with the setting up and managing of this project, the CCG was unable to begin work on this project and was therefore withdrawn.

Contact: John Askham (613) 991-3127
Project Number: FKDA6

Mechanical Recovery of Oil in Ice Infested Waters (MORICE)

This project was motivated by the lack of efficient techniques to clean up oil spills in ice infested waters. Several countries in the Northern Hemisphere face the potential of an oil spill in waters where ice is present for either part of the year or year round. These countries include Canada, USA, Sweden, Finland, Norway, Germany and Russia, all of which have pursued R&D activities to improve their capability to remove oil in ice.

The research activities in this field have not been coordinated internationally, but rather have been conducted in a scattered fashion. A collective international effort is considered necessary to achieve a significant improvement in the capability of dealing with oil spills in ice.

The overall objective of this project was to improve equipment and techniques to effectively recover oil that is spilled in ice infested waters. It is a multi-phase project consisting of analysis then prototype development of improved mechancial devices. This project will consist of 5 Phases.

Phase 1 of the MORICE Program involved an extensive literature review to identify available information from previous efforts to develop oil-in-ice recovery technologies As a result, ten concepts were suggested and discussed in detail by a Technical Committee. Phase 1 was completed in June 1996.

Phase 2 of the Program involved qualitative laboratory testing of most of the concepts suggested in Phase 1. The lab tests in Phase 2 were carried out at SINTEF's Cold Climate Testing Facility in Trondheim, Norway where ice-infested water conditions were simulated. This phase started in February 1997 and was completed in early 1998.

Phase 3 focused on continued development of two concept components that were selected from Phase 2, the lifting grated belt and the brush-drum system. Detailed quantitative testing was conducted on these concepts at a larger scale. This phase also initiated conceptualisation of the vessels and operating platforms for Phase 4 prototypes.

Phase 4 was conducted this year. The prototype skimmer was shipped to the Alaska Clean Seas facility in Prudhoe Bay, Alaska, and was prepared for performance tests in a land pit and the Beaufort Sea. The land pit test was to consist of recovering oil using the MORICE skimmer in ice covered waters, however, due to an early frost, the land pit froze solid earlier than expected, thus preventing any land pit tests from being carried out. As a result, efforts were concentrated on preparing the skimmer for the operational test in the Beaufort Sea. After several days of modifications and preparations, the MORICE skimmer was introduced into the Beaufort Sea where it was able to process ice as thick as 32 cm without any problems. No oil was used during this test.

Contact: Sergio DiFranco ((613) 990-3375
Project Number: FKDC6

Enhanced Sweeping Methods

The Canadian Coast Guard maintains and operates the vast majority of offshore cleanup equipment in the country. The present inventory consists of " state of the art " V sweep systems that allow maximum swath width operation thereby collecting oil from the largest possible area. These systems achieve a forward sweep speed of approximately one knot. If a system can be developed that maintained the swath width while sweeping at a much greater speed a larger area could be covered, collecting larger volumes of product which would otherwise wash ashore causing greater shoreline environmental damage. Additionally, the vessels used as platforms would operate more efficiently and be able to maintain positive control of operation.

The maximum forward speed of one knot can not be maintained easily by many vessels. To hold this slow speed these vessels must continually clutch and de-clutch causing damage to the vessels running gear with the result that the unit would have to be retired from the operation quite early, often within 12 working hours. This clutching and de-clutching also causes the sweep systems to pulsate resulting in the loss of oil at each cycle.

To help alleviate the problems encountered while operating sweep systems, CCG decided to evaluate a boom developed by a Norwegian boom manufacturer that has the potential to achieve sweeping speeds as high as four knots.

A copy of this boom was obtained from the SERVS response centre of Valdez Alaska. Tests were conducted in Patricia Bay, Vancouver Island and included CCG personnel from all Regions, personnel from Burrard Clean Operations (BCO), a representative from SERVS and NOFI.

Both CCG and BCO vessels were used during the test. A variety of test runs were conducted including towing the boom at various speeds, towing the boom into and with the wind, towing the boom while operating an MI-30 skimmer and simulating an oil spill recovery operation with various food products.

Following the trials, all participants involved met to discuss the trials and the performance of the boom in general.

Contact: Sergio DiFranco ((613) 990-3375
Project Number: FKDD6

Maritime Activity & Risk Mapping for SAR Planning

In order to address the deficiencies in the type and scope of management and strategic information available to assess the need and deployment of Search and Rescue (SAR) resources for SAR coverage, the Maritime Activity & Risk Mapping for SAR Planning project was commenced. This project was to develop and validate a Geographic Information System (GIS) based risk model of maritime activities. Research was commenced to determine what the significant risk factors were associated with different types of incidents and activities. Analyses were conducted on various activity classes to determine which factors were good predictors of incidents, and what trends would be anticipated. The underlying model was further integrated with the SARMAP computer program, previously developed in the preliminary stages of the project. This will assist management by displaying geo-referenced patterns, permitting querying according to various criteria, and illustrating areas of greatest risk to human life.

Part of this year's work included consolidating all data and information from the initial phase of the project, and the preparation of a detailed work plan which also included the following four elements: Data Collection; Analysis; Mapping; and Decision Aids.

Also accomplished this year was the production of a report entitled "Recreational/Tourism Marine Activity Assessment in the Bay of Fundy, Nova Scotia". This report describes and compares various methods of collecting the data on recreational/tourism marine activity. It then relates the process and results of two pilot tests to gather information by directed aerial observation. It also presents information on commercial recreational boating (rentals, tours, cruises), and describes how to model these activities.

Due to some contracting challenges, this year's project was unable to expend it's full budget allotment. As a result, the project will be completed, in future years, in partnership with The GEOIDE Network. GEOIDE Network (Geomatics for Informed Decisions) – is an R&D investment program currently consolidating Canadian expertise in geomatics. As a federally supported Network of Centres of Excellence, GEOIDE brings together many of the country's leading experts from 24 universities, 27 companies and 17 government agencies and departments.

GEOIDE selects and manages opportunity-driven R&D projects through our collaborative R&D investment program (Fisheries and Oceans Canada is a partner). GEOIDE is not-for-profit and is open to Canadian organizations whose own R&D and business efforts could be enhanced through the development and exploitation of geomatics technologies.

Contact: Brian LeBlanc (613) 990-5882
Project Number: FKDE6

Extending Temporary Storage Capacity Offshore with Emulsion Breakers

Emulsified oil poses various problems to those carrying out marine oil spill response operations. Temporary storage devices can become quickly filled up resulting in a less efficient and more costly response. Since emulsified oil can easily contain 70% to 80% water, most of the recovered product can be water and not oil.

This project assessed the effectiveness of chemical emulsion breakers (also called demulsifiers) combined with rapid decanting and treatment of the effluent in facilitating open ocean containment and recovery operations. A series of tests at Ohmsett was conducted to determine the capabilities and limitations of the chemical emulsion breakers by dramatically reducing the water content of recovered fluids, thus extending onsite temporary storage space.

This is a multi-year project involving six tasks. Task 1, completed this year, involved reviewing the literature on the use of emulsion breakers to improve recovery operation efficiency and designing the lab-scale test apparatus and test plan. A world-wide computerized literature review was carried out to uncover work that the study team was not already familiar with. Test oils (Calsol, Hydrocal and Sundex, and one or two common crude oils) and candidate demulsifiers was identified and standard laboratory emulsification and demulsifier tests was carried out to identify suitable oil/demulsifier combinations for the subsequent test series.

Potential emulsion breaker injection points in open ocean recovery systems were identified, and enhanced mixing schemes reviewed. Simple lab-scale test loops, mimicking a skimming head, internal pump, cargo/transfer hose, valving, manifolds and temporary storage tankage, were designed to allow small-scale model testing of the various injection points and augmented mixing concepts.

Contact: Sergio DiFranco ((613) 990-3375
Project Number: FKDF6

White Paper on Future Directions for CCG Oil Spill R&D

Over the years, funding of oil spill Research and Development has dramatically decreased and programs have been cut both in government and in industry. To survive, international organizations with oil spill R&D responsibilities have agreed in many instances to pool resources and fund research of mutual interest.

There are two steps in the partnering process. The first was to fully understand the Canadian Coast Guard's oil spill R&D objectives and strengths. This was partially achieved by reviewing oil spill research programs funded by CCG over the last 10 years and the success achieved in these. The second step was to survey other oil spill research funding organizations to determine their interests and plans. Determining the directions taken by others helped CCG RSER R&D decide whether there is common ground and an opportunity for joint venturing in certain areas and to make best use of limited funds that are available and to share the financial and management burden with like-minded groups around the world.

This year's project involved a study of the state of international oil spill research plans with the objective of recommending to CCG a series of options for long-term R&D funding. The three phases involved a review or programs funded by CCG over the last 10 years and their achieved successes as well as a survey of funding organizations determining their program objectives, directions and focus. A white paper recommending how to leverage CCG R&D funds over the next five years is included in the final report and will also define other possible areas of oil spill R&D in which CCG should consider taking the lead.

Contact: Ron MacKay (902) 368-0204
Project Number: FKDG6

Research & Development Plan
Year-End Budget Summary
1999-2000

PROJECT NUMBER	PROJECT TITLE	FUND SOURCE	1999/2000 FUNDS	
			CCG	PARTNER
FVGY1	Coherent Ultra High Frequency Radar (HHF)	NSS	22	
FVAD6	Production of current Field Using SLDMB's	NSS	9.4	
FVAE1	Enhanced Low Light Target Detection – ARU	NSS	121.2	
FVAM5	Voice Detection (Land & Sea)	NSS	94	
NSS – New Initiatives Fund – TOTAL			246.6	

NSS – NEW INITIATIVES FUND

NIF Input to 1999-2000 Annual Report

The New SAR Initiatives Fund (NIF) was established to provide funding for projects that will enhance search and rescue in Canada and are in support of the objectives and plans of the National Search and Rescue Program (NSP). These priority areas include:

- Saving lives throughout Canada's jurisdictional areas;
- Promoting the prevention or mitigation of SAR events, injury and loss of life;
- Performing all SAR functions effectively, efficiently and economically; and,
- Providing timely research and development products ensuring the Canadian SAR system meets the challenges of the next century; communications; search technology, theory and practice; and resource management.

The NSP encompasses the efforts and activities of all levels of government, corporate and volunteer sectors, and a vast array of organizations and programs related to providing information, applying technology, conducting research, preventing SAR incidents from occurring or saving lives of people at risk.

The Department of National Defence (DND) through the National Search and Rescue Secretariat (NSS) provides a means to coordinate the development of search and rescue activities throughout Canada and is responsible for the coordination of NIF nationally. The NSS reports directly to and manages NIFs on behalf of the Lead Minister for Search and Rescue (LMSAR).

Each NIF proposal is subjected to an intense scoring and ranking process performed by the Interdepartmental Committee on SAR (ICSAR) which include: Parks Canada Agency; Environment Canada; Department of National Defence; National Search and Rescue Secretariat (for the Provinces); Department of Fisheries and Oceans; Transport Canada; and the RCMP. For all NIF funding requests, these sponsors follow a set of priority categories which include integration of NSP; the collection of SAR data; prevention; volunteers; response; or, R&D.

Since one component of the NIF program is Research and Development, in 1999-2000 funding was provided to the Canadian Coast Guard and used for the following projects:

Coherent Ultra High Frequency (UHF) radar

Conventional microwave radars of the type found on most vessels are limited in their ability to detect small targets, particularly in high sea states. This primarily results from the radars that are non-coherent in operation so signal enhancement gained through processing multiple returns is limited and electromagnetic signals at microwave frequencies resonate with ocean wave components resulting in high levels of backscatter (clutter). Furthermore, adequate models for sea clutter are not available so robust and effective clutter suppression cannot be implemented.

The primary objective of this project was to develop a prototype radar that could be used to evaluate the benefits of using UHF frequencies for the detection of small targets such as liferafts and small icebergs in high sea-states. The UHF spectrum has been proven to provide a 'window' where the clutter energy scattered back from a sea surface is significantly less than at other radar frequency bands. In addition, coherent radar operation can be achieved at UHF with off-the-shelf cell phone technology.

For the first nine months of this project, the main effort was assembling the components for the prototype radar. This included the development of transmit and receive systems capable of coherent operation in the UHF Band. In addition, a software suite was developed to capture and process the UHF radar echoes. Following this development effort, the UHF Radar was field tested in Newfoundland against a conventional X-Band radar. With support from an Alaskan agency, the UHF radar prototype was field tested in Prince William Sound, AK for 4 weeks.

The field trials in Newfoundland and Alaska with the UHF radar clearly showed that there are benefits to using UHF frequencies for the detection of targets in high sea-states: At intermediate and far ranges, the amount of ocean clutter received by the UHF radar is less than that of standard marine radars; the increase in ocean clutter received by UHF radar with increasing wind speed is less than that of S and X band marine radars; and coherent operation allows for enhanced detection of weak targets in the presence of clutter and that doppler processing may be used to remove clutter to detect weak slow moving targets.

To evaluate the radar prototype, radar returns were compared to historical data present in several significant references. In addition, calibrated targets were used to measure the amount of clutter received by the radar system in the field, to compare with historical data.

Production of Current Field Using SLDMB's to Improve SAR Planning

Through trials conducted by the Canadian Coast Guard, the Department of National Defense and the U.S. Coast Guard, it has been demonstrated that the accuracy of marine search planning is greatly improved by using near real-time current data. Through recent Canadian Coast Guard R&D projects, it was determined that the most reliable means of obtaining this data is by inserting the information obtained from "Self-Locating Datum Marker Buoys" (SLDMB) into a search planning program.

Through a recent project sponsored by the NSS "New SAR Initiatives Fund", the SLDMB has been developed and placed in service aboard CF SAR aircraft and CCG SAR vessels. The SLDMB has already been used in 3 SAR missions and is credited with saving a life when the M/V Vanessa sank in mid-Atlantic.

Further, the CCG is completing a project called "The Transfer of SLDMB Data to SAR Coordinators" project. This project has provided the necessary shore network for transferring SLDMB data to the RCC/MRSC computer workstations.

The objective with this year's project was to consolidate SLDMB data at the RC/MRSCs into one current field which displays actual and predicted current in the vicinity of the search. At present, the SAR Coordinator must attempt to consolidate data from multiple SLDMBs and make a prediction on current. This is an inefficient process.

This project was delayed longer than expected due to Y2K issues however project objectives will be able to be met with the funds planned for in the second phase.

Enhanced Low-Light Target Detection System - ARUN Lifeboats

In maritime search and rescue, the ability to detect small targets (such as liferafts and people in the water) in low light conditions, will often result in the saving of lives and the timely resolution of a marine SAR incident. The ARUN Lifeboat, although a very capable SAR resource, is limited in this area of SAR operations. The extreme motion of the ARUN often precludes the placement of lookouts on the flybridge while conducting search operations in heavy weather; especially during periods of darkness and reduced visibility. To ensure crew safety it is often necessary to post lookouts from inside the wheelhouse. Under these circumstances, the effectiveness of the lookout is detrimentally effected. The reduction in the lookout's "height of the eye" and the constant "washing" of the wheelhouse windows limits the ability of the lookout to detect small targets. This could result in a loss of life and the non-resolution of a marine SAR incident.

It was proposed that the Canadian Coast Guard Cutter (CCGC) W.G. George (stationed at Burgeo, Newfoundland) be fitted with the ITT Night Navigator 8503 System. The Night Navigator offers exceptional low light performance and image clarity by incorporating a high resolution Generation III image intensifier, a 6 million candlepower infrared searchlight and a 6 million candlepower white light searchlight in a combined unit. Controlled remotely, all images are monitored from a display in the safety of the wheelhouse. The mounting of the unit on the flybridge will ensure a sufficient "height of eye" for search operations and enhance target detection capabilities without compromising crew safety and comfort. This system will also provide advanced visual warning of hazards in the water (floating debris and wreckage), thus complementing RADAR and enhancing the safety of the ship.

Testing of the Night Navigator System installed on the CCGC Cap Goéland, continued during the last quarter of FY 99/00. The Night Navigator was evaluated against visual lookouts and Generation III hand-held night vision goggles. Targets used in the trial were a 4 person liferaft, an immersion suit and a poly buoy to simulate the head of a person in the water. Initial trials show that the Night Navigator System is extremely effective for low light target detection during slight sea conditions. The preliminary report for year 1 has been completed.

Voice Detection (Land and Sea)

This project's goal was to develop a system which would be able to perform in high-speed searches acoustically and greatly increase the probability of survival of persons in distress. The system would detect, classify and localize acoustic events (cries for help, air horns, etc.) while in the presence of masking noise. This system would greatly increase the efficiency of local searches, thus reducing search times and increasing the chances of survival of persons in distress.

Work during January to March 2000 had demonstrated that exceeding the performance of the human ear is possible in large ship environments and a method of beating wind noise in microphones was developed. This was a revolutionary discovery considering that the problem had existed since the 1920's with no good solution up until our discovery. Wavemakers has applied for a patent for the technique. We will show this system to anyone who visits our Victoria office but for patent security reasons are not posting details of the design in the report. However sound samples taken in high wind conditions are posted on the multimedia interim technical report for March 2000.

Field work was carried out on board several Coast Guard boats including the Sir Wilfred Laurier in Victoria and the Kitsilano fleet in Vancouver. It was observed that we can already provide for enhanced hearing on the larger ships. The smaller rescue boats are more of a challenge but we have something that may work in this environment. The methods are outlined in the interim technical report. A multimedia interim technical report with sounds, examples and photographs is on line at http://www.rescuears.com . Click on the Report near the top of the web page.

Wavemakers has perfected a software package called "Far Field Speech Detect" which will automatically distinguish speech from noise. This will allow an automated listening system to be developed that is constantly watching for voices. A demo of this software has been shown to Coast Guard personnel at our Victoria office.

A detailed final summary report for each of the above mentioned projects can be obtained by checking out the NSS website at:

http://www.nss.gc.ca

RESEARCH AND DEVELOPMENT OFFICE

The focal point for planning, coordinating and reporting of CCG R&D activities. Projects are initiated when required to promote CCG issues with other government departments, the marine community and international agencies.

Research & Development Plan
Year-End Budget Summary
1999 – 2000

PROJECT NUMBER	PROJECT TITLE	FUND SOURCE	2000/2001 FUNDS	
			CCG	PARTNER
FMAA6	NRC Industrial Benefits Management	CCG	167.9	

CCG R&D Office – TOTAL		167.9	

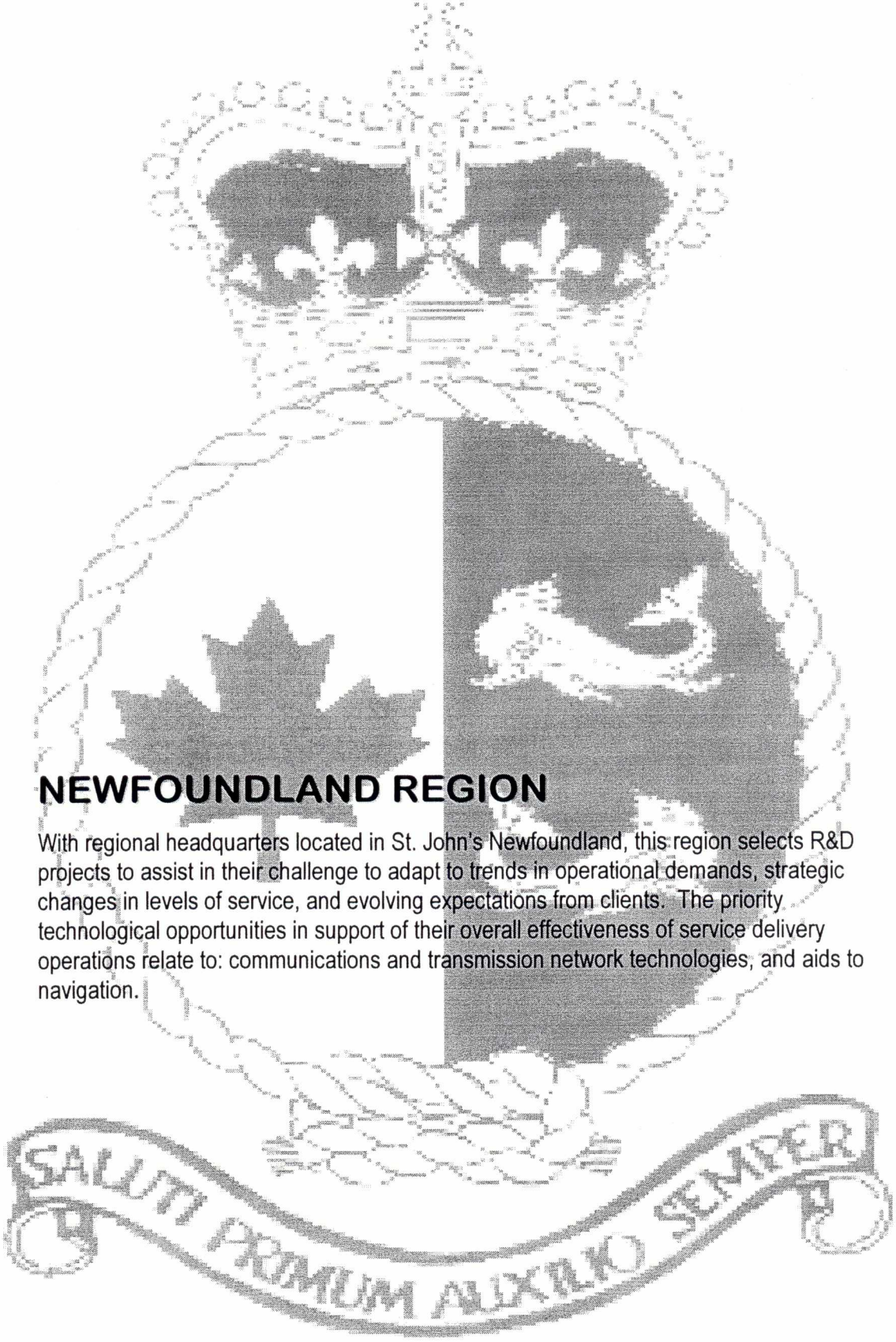
NRC Industrial Benefits Management

The management of the Canadian Coast Guard (CCG) R&D projects to obtain maximum industrial benefits in Canada is a complex undertaking. The knowledge and skills required to identify industrial opportunities and to negotiate viable business arrangements, having benefits to the Crown, resides in special pockets of expertise. The NRC supports one such specialized office for the management of intellectual property (IP).

The CCG has established a master agreement within which the NRC IP office can provide advice and assistance to CCG project mangers on an ongoing basis.

The master agreement is in effect until March 2002. Annually, project managers will be given the opportunity to review CCG IP management needs.

Contact: W. Ellwood (613) 990-3087
Project Number: FMAA6



NEWFOUNDLAND REGION

With regional headquarters located in St. John's Newfoundland, this region selects R&D projects to assist in their challenge to adapt to trends in operational demands, strategic changes in levels of service, and evolving expectations from clients. The priority technological opportunities in support of their overall effectiveness of service delivery operations relate to: communications and transmission network technologies, and aids to navigation.

Research & Development Plan
Year-End Budget Summary
1999-2000

PROJECT CODE	PROJECT TITLE	FUND SOURCE	1999/2000 FUNDS	
			CCG	PARTNER
FMBA1	Radar Infrastructure Cost Reduction	CCG	23	
FMBB1	Ships Voyage Data Recorder	CCG	180	675
FMBC1	Geospatial Display of SIPA Data	CCG	90	
FMBD1	Ship/Shore Communications Architecture	CCG	58	
Newfoundland – TOTAL		CCG	351	675

Radar Infrastructure Cost Reduction (Radar WAN)

The cost of supporting the current infrastructure for radar coverage in high level vessel traffic zones is rapidly outpacing the ability of the Canadian Coast Guard (CCG) to re-invest capital. To reduce the cost of CCG service delivery, less expensive means of replacing this infrastructure should be investigated.

This project proposes to demonstrate proof of concept that spread spectrum radio systems can perform the same function as point to point microwave systems in the transmission of broadband radar signals. Issues of maximum range, bandwidth requirements, and the effects on signal fidelity will be addressed. The project will demonstrate that spread spectrum systems can meet the operational requirements of MCTS, and will quantify the captial and maintenance costs of these systems.

Testing of wireless WAN equipment in house prior to installing the WAN link between Pearce Peak and MCTS Placentia was carried out. After the wireless link had been installed by TEW, Sigma installed and configured the necessary radar equipment. This took several months as multiple trips were made by Sigma to alleviate problems encountered during the initial installation. As well, a tracking unit was later installed with the radar equipment to provide ARPA targets for the AIS trials. The system still has problems, which must be resolved before either the AIS trials or Radar WAN tests can be carried out. The CCG is currently working with Sigma Engineering to resolve this situation.

Contact: Jane Kelsey (709) 772-7935
Project Number: FMBA1

Ship's Voyage Data Recorder

The International Maritime Organization (IMO) is now in the process of adopting a convention which will mandate ships to carry voyage data recorders (VDR) or Black Boxes. The VDR has numerous benefits for Fleet Management ranging from post incident analysis, situation training, economic evaluation of vessel operation, and others. Canadian involvement with this work will promote a standard that recognizes Canadian experience.

This unit will be used to log a ships voyage collect critical information related to the circumstances and causes leading up to an incident. The unit will record ships sensors (radar, sounders, gyro, DGPS), ships equipment (rudder angle, engine RPM, etc), internal and external radio communications, weather conditions and aural bridge environment. This year's project was to evaluate a Voyage Data Recorder (VDR) and document the benefits for Coast Guard.

After extensive testing and a site acceptance test at contractor's premises (Rutter Technologies), the Voyage Data Recorder (VDR) was installed on the CCG ship Ann Harvey Feb., 1999 and tests were conducted for a period of 12 months while the ship was in an operational mode. Rutter has made several visits to the ship over the testing period to modify and improve the design of the unit and resolve minor problems, especially with regard to the playback system.

Proof of Performance test was performed in summer of 1999. All sensors and the recordings of the operation of the ship worked as per the specifications, however, we were not able to interface fire alarm system to unit.

At the present time the VDR is still installed aboard the Ann Harvey in an operational environment.

Contact: Jane Kelsey (709) 772-7935
Project Number: FMBB1

Geospatial Display of SIPA Data

The Aids to Navigation Database System (SIPA) is a national database of information used by Aids to Navigation for information on fixed and floating buoy deployment. It records pertinent information on buoy type, position, and maintenance information.

The R&D proposal addressed the shortcoming of the SIPA system and its inability to display information on a marine chart or topographic map. Traditionally, staff must manually plot proposed aid changes or obtain co-ordinate information from paper charts. This process is extremely time-consuming and leads to errors. The SIPA IMS Project proposes to increase efficiencies in

performing these tasks as well as other planning duties performed by Marine Navigation Services (MNS) staff by displaying maps and navigational aids on a computer screen. Retrieval of electronic charts, the display of aid information and the resulting planning manipulations could be performed electronically with greater efficiency and accuracy.

The system has been proven under the R&D project and is currently functioning and available for limited use. A number of demonstrations have been held for various CCG sectors and a number of parties from within MNS and other sectors have shown interest. A demonstration of the system can be arranged through the system developer in the Newfoundland Region.

The project has progressed from R&D through to partial development and the resolution of challenges as outlined below:

The work performed and completed during the CCG R&D project affirmed the feasibility of the system. The main focus was to illustrate that SIPA information could indeed be displayed successfully on an electronic chart using a Server and Intranet Browser such Microsoft's Internet Explorer.

Advantages

As outlined, many of the features of the SIPA IMS system directly or indirectly result in cost savings:

- Users of the system nationally will access all electronic charts available for the country. Accessing electronic charts via SIPA IMS could save upwards of $245,000 in electronic chart licensing fees (based on 200 users).

- As SIPA IMS is based on a client/server model, the cost of maintaining the system is considerably less than that of stand-alone personal computer based systems. Maintenance cost from both a human resource and software license perspective will be significantly decreased. Individual desktop software systems (costing approximately $2000 each) are no longer required and the number of trips to each desktop will decrease significantly.

- Standardization on one national system allowing for efficiencies in training, use of the system, and synergy in the future development of system needs.

The future

Work will continue without funding, on the project in Fiscal 2000/01 focusing mainly on providing specific functionality to assist Aids to Navigation planners to efficiently perform their duties and to also seek funding to carry on with development of the system.

Due to advanced planning, the SIPA IMS system is based on a similar platform to that of MAPRATS (a regional stand-alone system in use in Pacific Region). As a result, building MAPRATS functionality in to SIPA IMS is possible. A small portion of this functionality has been developed to further prove the system. But, only five percent of MAPRATS functionality has currently been incorporated into the SIPA IMS system. Further funding will be required to set priorities and complete this portion of the project.

Contact: Don Duffie (709) 772-6419
Project Number: FMBC1

Integrated Vessel Ship to Shore Data Communications

The communication of information between vessels of the CCG fleet and land based CCG offices has been steadily growing over recent years. This information is in the form of email text, electronic files (email attachments, ice images, etc) and facsimile (fax). Given the very nature of vessels at sea, the communications links used for the transmission of data are inherently unreliable and will probably remain thus. Another problem is that the technologies used to communicate with vessels is based on operational parameters unique to land-based applications.

These two problems make for a very inefficient system of communications between our land based offices and the CCG fleet. Information such as faxes must be retransmitted numerous times to ensure the full contents have been received by the vessels. Also, many voice calls must be made to verify reception of this important information. Thus, when you include both the cost to actually send the document and the cost to "verify" reception, the end result is very high priced communications.

NEWFOUNDLAND

During the project, a number of avenues for the delivery of efficient and integrated vessel data communications were investigated. The findings revealed that an off-the-shelf product, On-Air Mobile manufactured by Telesis North of Toronto performed many of the key functions outlined in the proposal. The product provided the following key advantages and functionalities:

- It integrated seamlessly with Exchange Server and Outlook, the current DFO standards for email.
- A benefit of the Exchange/Outlook architecture meant it could be more readily accepted as part the main DFO architecture.
- The product recovered from disconnects and was able to continue a file transfer from the point of loss of communications.
- The product compressed all emails automatically.
- On-Air worked over the myriad of communications media used on vessels (WiLAN, Cell, MSat or Inmarsat, etc)
- The product was off the shelf and required no specific software development to implement the initial roll out of the system.

Other findings and developments include the following:

- AT&T Paradyne 3825 Plus modems work well in this harsh communications environment
- Fax receipt and transmission software installed on the Exchange server allowed for faxes destined to the vessels, could be stored, along with regular email, and downloaded using a single phone call and taking advantage of extra compression provided by On-Air.
- A small prototype forms package was developed to allow only textual information to be transferred between shore and vessel. The system worked, by only minimal development was performed. A search for a suitable off-the-shelf substitute was not performed.

As of the new fiscal year, Newfoundland Region is in the process of implementing the system for wide spread use throughout the fleet. Further deployment of Fax and forms capabilities will be evaluated in the future.

Contact: Don Duffie (709) 772-6419
Project Number: FMBD1

MARITIMES REGION

With regional headquarters located in Dartmouth, N.S., this region selects R&D projects to assist in their challenge to adapt to trends in operational demands, strategic changs in levels of service, and evolving expectations from clients. The priority technological opportunities in support of their overall effectiveness of service delivery operations relate to:
ice data collection and information management.

Research & Development Plan
Year-End Budget Summary
1999-2000

PROJECT CODE	PROJECT TITLE	FUND SOURCE	1999/2000 FUNDS	
			CCG	PARTNER
FMDB2	Northumberland Strait Ice Manager	CCG	24.1	
FMDC2	Fixed Mount Ice Probe Initiative	CCG	116.8	
Maritimes Region - TOTAL		CCG	140.9	

MARITIMES REGION

Northumberland Strait Ice Manager

Although the light ice conditions of the last two years have resulted in reduced numbers of Canadian Coast Guard (CCG) escorts, the continuing possibility of an true El Nino year may mean exterme ice conditions, giving the CCG difficulties in providing ice routing and ice breaking asistance.

The CCG is also faced with the task of monitoring the effects of the new Confederation Bridge on ice conditions in the Northumberland Strait. The foreknowlege of ice convergence resulting in ice pressure events in the vicinity of the Bridge is of vital importance in order to avoid commercial shipping (mainly oil tankers) being trapped by drifting ice while attempting to transit the navigation spans. Since CCG currently have no means of knowing or predicting ice pressure events west of the Bridge, especially in the approaches to the shipping lanes, the risk of a vessel being at the mercy of ice under pressure is high.

During the 1996/97 season of ice beacons were successfully deployed west of, and recovered east of the bridge using an ARGO range finder mounted on a CCG helicopter. These provide in real-time ice dift. Another sensor used is the "Ice Probe" towed by CCG's 105 helicopters that is capable of measuring the snow-plus-ice thickness distributions of the pack ice along long flight lines in the vicinity of the Bridge. The IceManager is conceived as a system which would build upon work with these various sensors in one comprehensive operational tool to assimulate the data and forecasts by ice-ocean model the regional ice conditions required to direct marine traffic near the Bridge.

Funds were provided to the CCG in order to participate in the sea ice program studying the affect of the Federation Bridge on the pack ice properties in Northumberland Strait by DFO/Science/Maritimes and NRC/Ottawa. The CCG Ice probe was used to document the regional ice thickness distribution while a second DFO sensor (Video/laser) provided data ice roughness, concentration and floe/lead distributions. NRC instrumentation in the bridge pier monitored the pressure exerted pack the pack ice on the bridge while DFO moorings documented the ocean and ice drift rates and ice draft distribution near the instrumented bridge pier.

The funds provided to the Ice Manger project were also used to refurbish the Ice Probe which was then used during the months of February and March. Its data was distributed in real-time to CCG and Can Ice Service for their inclusion in the ice maps distributed to mariners. Results were marginal to operational needs.

Contact: Jim Calvesbert (902) 426-3797
Project Number: FMDB2

Fixed Mount Ice Probe

The preliminary design of a sea ice thickness sensor intended for direct mounting to a Canadian Coast Guard MBBO helicopter has been successfully completed. The most serious unknowns remaining at this point of the design analysis are the amplitude of vibrational noise generated by movement of the sensor reltive to the helicopter and the amount of drift to be expected due to temperature changes. Modelling techniques were used to conduct preliminary investigation, but experimental measurements will be required to determine their actual behaviour.

The project included the design, production and testing of a rapid and accurate means of making spot estimates of sea ice thickness from their helicopters using a fixed mount electro-magnetic (EM) sensor. The work was awarded to Geosensors Inc. whose personnel had previously manufactured the towed version of the CCG Ice Probe. Due to DSS open bid system, the awarding of the contract was delayed to the fall of 1999.

The design and construction of the fixed-mount EM Ice Probe was completed before the end of the Fiscal Year as planned in the original project plan while the actual testing and delivery of the system will not occur until the second year of this project (2000/01 ice season).

Additional funding and logistic support are required from other sea ice projects to complete the construction and testing of the fixed-mount system as the original estimated cost increased from $135k to $160k. The additional cost is partially due to the cost associated with the aeronautical engineering work and flight approval certification required underTransport Canada regulations.

Contact: Jim Calvesbert (902) 426-3797
Project Number: FMDC2

LAURENTIAN REGION

R&D projects are designed to assist in adapting to local trends in operational demands, strategic changes in levels of service and evolving expectation from clients.

New and emerging technologies are explored to support overall effectiveness of service delivery operations for the Laurentian region.

Research & Development Plan
Year-End Budget Summary
1999-2000

PROJECT CODE	PROJECT TITLE	FUND SOURCE	1999/2000 FUNDS	
			CCG	PARTNER
FMCA3	Analysis of Risk Associated with Mercury in Lighthouses	CCG	45.3	
FMCC3	Erosion/Sedimentation	CCG	53	
FMCD3	Helicopter Fixed-mount Detection of "Brash" Ice Thickness in Fresh Water	CCG	54.2	
FMCE3	Surface Current Tracking System Using Radio and Satellite links: drifting buoys	CCG	11.2	
Laurentian Region - TOTAL		CCG	163.7	

Analysis of Risk Associated with Mercury in Lighthouses

The Canadian Coast Guard (CCG) Laurentian Region has 36 lighthouses and some of these are soon to be transferred to other federal or provincial departments or to municipalities. It is therefore important to indicate the actual state of the lighthouses to be delivered to purchasers.

In the Fall of 1994, a program which focussed on soil clean-up was implemented at regional sites. The removal of mercury was added to that program in the Spring of 1996. Mercury was used to ensure the rotation of the prism in lighthouses. Today, mercury can be found in the ambient air and surface of the lighthouses. A procedure to withdraw the mercury still present in the tanks was developed. With the help of a reactive product, this procedure also allows to decontaminate the lighthouse and seal it with an Expoxy-based paint.

Partial results of a follow-up done in July 1997 allowed to assess the efficiency of the procedure used. A considerable reduction of the mercury concentration in the air and on surfaces was noted. A follow up is being done to assess the durability of the method used.

Despite these efforts, some mercury residues can still be noticed after decontamination work is performed. In certain cases, the reappearance of mercury on some metal element devices in the lighthouse can be observed. The potential risk associated with the presence of such residues is unknown.

During the first and the second years of the project, the steps used to validate the action and the orientation of this study have been performed, and the risk analysis, per se, has been initiated. Overall, based on the steps performed during the last year, the defined objectives will be achieved within the anticipated timeframe. The following steps have been performed:

Refining the decontamination method

- Perfecting the physical method of removing visible mercury: assessment of the effectiveness of the devices used for this purpose, and optimization of procedures.
- Estimating the effectiveness of the range and the duration of chemical surface treatment: effectiveness of the products used, duration and follow-up of the procedures used.

Validating the overall procedure used to estimate risk

- Estimating the residual risk subsequent to decontamination, the ventilation facilities installed and the adoption of personal safety measures.

Contact: Francine Richard (418) 648-4794
Project Number: FMCA3

Erosion/Sedimentation

The purpose of this project is to finalize development of a sediment transportation model, combined with a visualization interface, for the purpose of better understanding the process of erosion, transportation and deposit of sediment in the St. Lawrence River, based on the various hydrologic and hydraulic conditions present, and to assess the potential impacts on navigation, and on the maintenance of the navigable waterway on the environment. To this end, the CCG has entered into an association with partners having common objectives: the Science Section of Fisheries and Oceans Canada, Environment Canada, the Québec Ministry of the Environment and National Research Council Canada.

The project is well on its way to completion. This year, two contracts were let. The first contract was let to National Research Council Canada (NRCC) and the second to the Institut national de la recherche scientifique (INRS-Eau). Both organizations were already involved in the development of leading-edge digital models of sedimentary transportation. Initially, the CCG and its partners want to equip themselves with the best of existing tools. With this goal in mind, two models for sedimentary transportation, which differed in the mathematical approach they used, were examined.

The INRS-Water model

The INRS-Water model favours a Eulerian approach. This approach implies that, when mathematical equations describing the problem of transportation of sediment are being solved, the entire zone under study (in our case, a section of the St. Lawrence River) must be rendered in the form of a model, something which generally involves extensive calculations.

A final technical report on this model was presented to the CCG in March 2000. The report describes the transportation-diffusion model for the Dispersim river environment. Dispersim enables simultaneous processing of several variables in outflow: suspended solids, dissolved oxygen, BOD, heavy metals, etc. This model is a bi-dimensional one, and uses the finished elements method for stationary cases (one point in time) or transitional cases (several points in time, changes over time). Owing to its Eulerian approach, the original model was intrinsically limited to small areas of studies. The challenge was to convert Dispersim, in order to make it usable for true and important real areas of study, such as a branch of the St. Lawrence.

A true section of Lake St. François, located between Summerstown and the Beauharnois Canal, was also modelized with success, which shows that this model is promising. However, additional validation is necessary to evaluate properly the results of this model, and to compare these results with true cases of sedimentary transportation in the St. Lawrence.

No user interface has yet been determined for Dispersim, which makes it a system which is not user-friendly. At present, a utility program makes it possible to construct Dispersim input data, and the results can be downloaded into a visualization and analysis application, the INRS-Water Modeler.

NRCC Model

The NRCC model promotes a Lagrangian approach. This approach implies, when mathematical equations describing the problem of sedimentary transport are solved, that only the zone alongside the transported sediment is to be modelled, something which generally enables calculations to be performed rapidly.

A preliminary technical report was presented to the CCG in March 2000. An interactive presentation was also made to the CCG and to the project partners on June 13, 2000. The report describes the development, the calibration and the validation of the PSed sediment transportation model. This model combines elements describing the advection, dispersion, erosion and deposition of sediment. This model is the first component of the SedSim transportation model. This model is included in a modelling environment which is already in existence, and is wider-ranging. This model is called EnSim. This environment makes it possible to view, in 3-D, the transportation of sediments in a physical environment of the fluvial or estuarian type.

This new model has also been used to model two sections of the St. Lawrence, opposite the North Crossing and Contrecoeur. The results are interesting ones, and demonstrate that the model is a promising one. However, some additional validation is necessary, to evaluate correctly the results of this model, and to compare it with actual cases of transportation of sediment in the St. Lawrence. The final version of the March 2000 report, which is expected for the summer of 2000, will make it possible to follow up on the information in this respect.

The model does not currently combine the influence of natural waves, nor the influence of waves induced by navigation in the process of transporting sediment. This step is the next one to be implemented.

The 3-d modeling interface appears to be stable, powerful and user-friendly.

Future Direction

During the autumn of 2000, the CCG will determine, in co-operation with its partners, which of the two models developed in 1999-2000 (NRCC et INRS-Water) will be used for the rest of the development. The finalizing of the components for the chosen model and the submission of the progress report are still expected for March 2001. It is planned that the analyses of the process of erosion and transportation of sediments in the St. Lawrence River, based on hydrologic and hydrodynamic conditions, will be completed for March 2002, and that the potential impact on navigation and maintenance of the navigable waterway on the environment will be completed for March 2003.

The working plan for the performance of this project in 2000-2001 is in the process of being drafted. It will include the inclusion, in the erosion/sedimentation model, of the influence of wind waves and of waves produced by navigation on the transportation of sediment, and on the erosion of the riverbanks.

Contact: Pierre Rouleau (418) 648-7493
Project Number: FMCC3

Helicopter Fixed-Mount Detection of "Brash" Ice

Ice observation is essential to effective ice-breaking and escort services for the cost-effective utilization of ice-breakers and for collecting the information required to reduce the risk of flooding. Despite several recent technological improvements in this area, we still have no means of quantitatively evaluating brash ice thickness in fresh water. Determining ice thickness is essential for (1) assessing the volume of ice that has to drift out through areas susceptible to the formation of ice jams, and (2) assessing the degree of hindrance to navigation in difficult conditions. This project would be an important addition to the concept that we have been advancing in recent years under the PERD project entitled "Integrated Ice System".

This project is designed to set up a helicopter fixed-mount system of detecting ice, capable of adequately characterizing all ice conditions which prevail in the St. Lawrence River and, in particular, fresh-water ice of the "brash" type. Knowing the thickness of the ice is essential to identify (1) the volume of ice which must be cleared out of areas where ice jams are likely to form and (2) to assess the resistance to navigation in conditions where there is a great deal of ice in the water. This project is a central aspect of the PRDE Project development work, the "Integrated Ice System".

To this end, the CCG has entered into an association with external partners having some common objectives: National Research Council Canada (NRCC), the Transportation Development Centre (TDC), the Cold Regions Research and Engineering Laboratory (CRREL-USA), the Bedford Institute of Oceanography (BIO), the Canadian Ice Centre (CIC), the Université Laval and the Institut national de la recherche scientifique (INRS).

It was essential to determine whether current technologies were sufficiently advanced to make it possible to be able to create a remote sensing system for ice, such as the one desired by the CCG. The NRCC report, submitted in December 1999, concluded that these technologies exist, and proposes that a prototype including the following components be constructed:

1. a pulse radar to measure the thickness of the snow and the thickness of solid ice;
2. a pulse radar for upper-level surface elevations of brash ice, and for the elevation of the water surface;
3. a remote-sensor laser to assess of the upper level of the ice, as a support to the pulse radar;
4. a video camera to document the type of ice, its concentration and its speed;
5. a DGPS for precise positioning and 3-D orientation;
6. a laptop computer for data acquisition.

The NRCC report states that all these components, with the exception of item 2, have attained a semi-operational development level, as a result of the efforts made by the BIO. Item 2, however, requires a significant development effort.

In effect, most of the research and development work performed in this area have dealt with ice conditions in salt water, and the radar systems tested to date have been insufficient to measure the thickness of brash-type ice, using airborne applications. The only method which has given successful experimental results for measuring the thickness of brash-type ice is the method developed by Daly and Arcone (1989). This method consists of using a low-frequency impulse radar (GPR) to measure the height at which the ice is floating (the ice cover) and to estimate its total thickness, using the ratio of ice/water densities. These authors have obtained an accuracy rate of (20% for the total ice thickness.

Subsequent to the conclusions contained in the NRCC report, a request for a proposal of services was published, and a contract was let, in January 2000, to the firm of Constellar Exploration to create and test a prototype.

The 1999-2000 project anticipated that flight testing would be conducted above all types of ice, including brash-type ice, as well as conducting a measuring campaign in the field, to validate the measurements provided by the helicopter-borne system. However, these trials could not begin before February 29, 2000, owing to the necessary timeframes required to have the manufacturing plans for the helicopter-bome platform and its assembly approved by Transport Canada. In addition, the early arrival of spring was such that there was

practically no longer any ice floating on Lac Saint-Pierre after March 1. These tests will be continued in 2000-2001 and the data will be validated using periodic measurements, as well as using data collected from instruments set out in Lac Saint-Pierre, namely, echosounding devices inverted in Islet 3 and the IPS (Ice Profiling System) at Curve 1. In addition, exchanges of information will be conducted with the BIO, to check if the equipment and the software packages used to process the data which they have developed over the years may be combined with the system currently being developed at the CCG.

The work to be performed over the winter of 2000-2001 will make it possible to make an assessment of the effectiveness of the method proposed to measure the thickness of brash-type ice. A final report, accompanied by recommendations, will be submitted in March 2001 and the CCG will have the information it needs to decide if any additional information can be devoted to developing an operational prototype of helicopter-borne remote sensing of freshwater ice thickness.

Contact: Reginald Corriveau (418) 648-5620
Project Number FMCD3

Surface Current Tracking System Using Radio and Satellite Links: Drifting Buoys

When a pollutant spill occurs, it is vital to have as much information as possible on the development of the situation, to be able to plan optimum response strategies for protecting lives, property and the environment. The essential information includes updates on the position of the pollutant slick. The use of drifting buoys that can be released at the spill site and can transmit their GPS (or DGPS) position by radio is an effective and inexpensive method. However, few companies sell drifting buoy systems that can be used to track pollutant slicks, and those buoys are ill-suited to our needs. The main constraints in selecting the best system are the distances to be covered and the varying scope of pollution occurrences. Because most cases occur near the shoreline, the use of satellites for reception is less cost-effective than VHF reception. Besides, the CCG already has a very good network of VHF repeaters and stations which should be exploited.

The main objective of this project is therefore to adapt a system of drifting buoys to the Canadian Coast Guard VHF MCTS system (digital network) and to make the information transmitted by the buoys available to those involved on a server so that all the information concerning the spill can then be georeferenced.

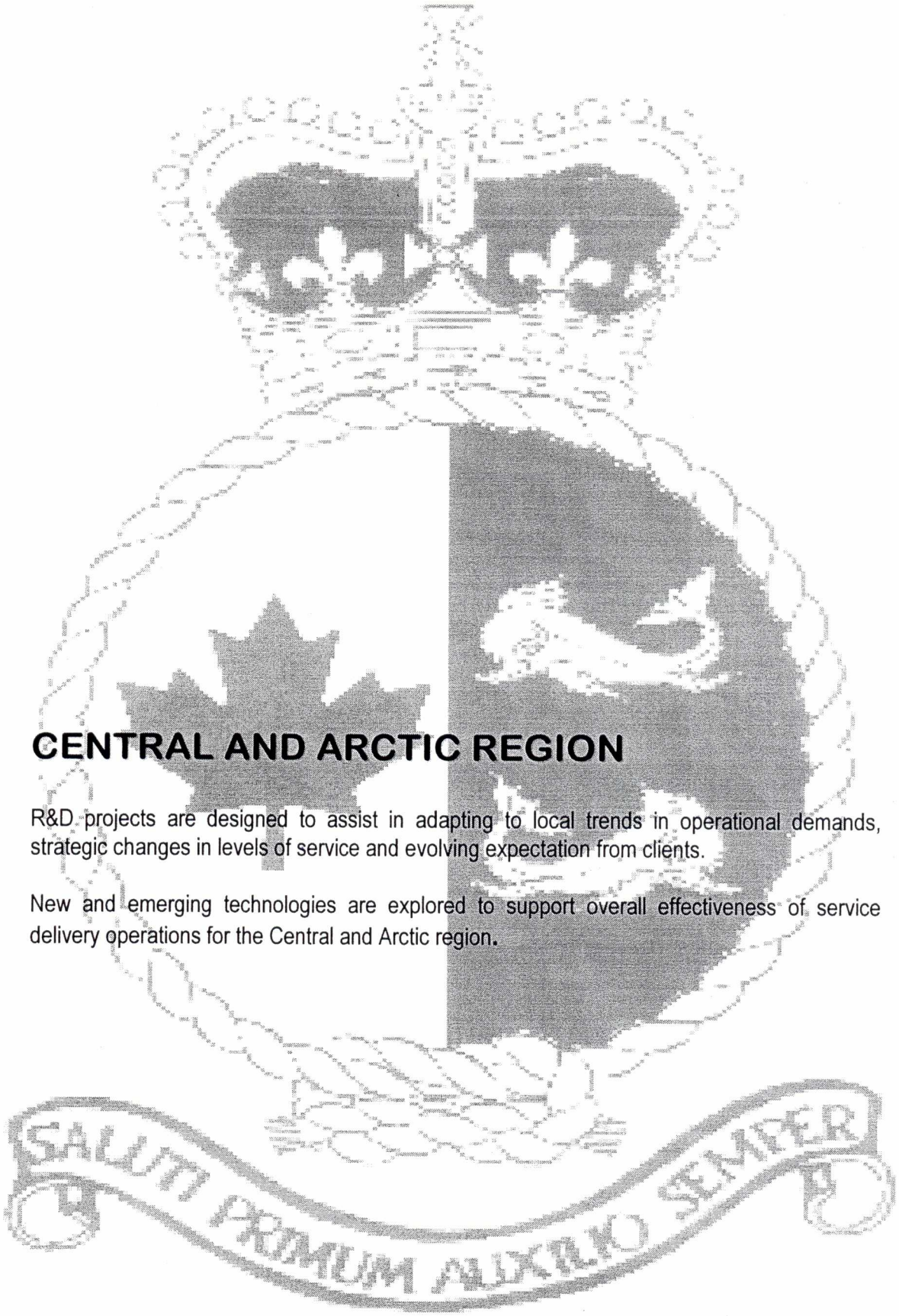
As part of the Canadian Coast Guard research and development program, Audace Technologies in Rimouski has developed a buoy, according to our specifications. Audace Technologies was able to deliver this buoy to us before March 31, 2000.

This buoy is now equipped with temperature sensors (air, water) and transmits its GPS position by satellite, using the Orbcomm network. The other parameters which can be transmitted are speed, direction of drift and the degree of charge remaining in the batteries which supply the buoy with electric current. These sensors allow, among other things, a better assessment of the evaporation speed of hydrocarbons and makes it possible to determine the physical condition of the product. Satellite transmission make it possible to obtain both excellent geographic coverage, as well as real-time access to the data transmitted by the buoy. The information transmitted reaches us by nothing more complicated than electronic mail. It is then a simple matter for us to redirect these data to our partners. In addition we can, at all times, modify the transmission parameters of the buoy, such as transmission frequency, by remote control. With position being transmitted once per hour, the buoy can function independently for an estimated period of almost 10 days. This data format is fully compatible with cartography software packages (SIG) in current use, and can be easily downloaded.

The Canadian Coast Guard, in co-operation with the Institut Maurice-Lamontagne, will be conducting sea trials during the summer of 2000 to assess the reliability and the autonomy of the new Audace buoy.

This project has been the subject of broadcast articles on the TVA network, both nationally and regionally. As well, an article was published on this subject in the April-May 2000 issue of InfOcéans.

Contact: Martin Blouin
Project Number: FMCE3



CENTRAL AND ARCTIC REGION

R&D projects are designed to assist in adapting to local trends in operational demands, strategic changes in levels of service and evolving expectation from clients.

New and emerging technologies are explored to support overall effectiveness of service delivery operations for the Central and Arctic region.

Research & Development Plan
Year-End Budget Summary
1999-2000

PROJECT CODE	PROJECT TITLE	FUND SOURCE	1999/2000 FUNDS	
			CCG	PARTNER
FRCU4	Industrial Noise Interference with Marine Mammal Communication - Dev't.of Tools for Objective Environmental Assessments	CCG	70	
FRCV4	Dev't. of Centre Line GPS Way Points Simpson Straits into Cambridge	CCG	100	
FRCW4	Modular Shipboard Water Treatment System	CCG	100	
FRCY4	Part 1: 2.4 Generator Set Part 2: 1.0 kw Small Ultra Light Weight	CCG CCG	25 33	
FRDB4	Monitoring System for 150 to 400kw Diesel Alternator Engine	CCG	0	

Central/Arctic Region – TOTAL	CCG	328	

Industrial Noise Interference with Marine Mammal Communication – Development of Tools for Objective Environmental Assessments

A previous project funded by the Canadian Coast Guard, Central & Arctic Region, studied the interference of icebreaker noise with beluga whale communication signals. Captive beluga whales at the Vancouver Aquarium were trained for masked hearing experiments. Animals indicated when a noise source was too loud for them to detect calls from conspecifics. Based on the data collected, computer software was developed to model the interference of ship noise with beluga calls and to predict masked hearing thresholds.

In 1998/99 data was collected and tools developed during the earlier project, zones of masking around a vessel were calculated for a realistic ocean environment. NORDREG statistics on vessel traffic are used to identify busy shipping routes in the Canadian Arctic. These are correlated with maps of beluga habitat. The Beaufort Sea and Amundson Gulf were identified as critical beluga habitat during the summer months. Geography, bottom geology and physical oceanography Data for this area are currently being gathered. With this data, a sound propagation model will be programmed for ship noise and beluga vocalizations in the Beaufort Sea.

Dr. Christine Erbe in British Columbia developed a software package for assessing noise effects on marine mammals. This software package takes sound recordings of underwater noise and models the spreading of sound through the ocean in a site-specific environment. The package further contains various biological impact models, which was devised through acoustic experiments with trained marine mammals at the Vancouver Aquarium and by putting known biological impacts into numerical models. The outcome of the package are zones of impact around the noise source, where the noise is audible to marine mammals, where it disturbs marine mammal behaviour, where it interferes with marine mammal communication and echolocation, and where it causes physiological damage to organs and tissues.

The software package can be applied to various types of noise (from small boats to large ships, oil exploration, drilling, seismic prospecting, shore- and offshore construction, mineral mining etc.), various types of ocean environments (arctic versus open ocean) and a number of marine mammal species. I have so far applied this to the case of icebreakers affecting beluga whales, whale-watching boats affecting killer whales, and passenger ferries affecting dolphins and seals.

The outcome of this study proved that icebreakers (being louder than any other ship) do not have any serious impact on beluga whales (such as physiological damage) over the distances that beluga whales approach them. In fact, beluga whales don't even get close enough to icebreakers during heavy ice-ramming, for masking of communication and echolocation to occur. This technique has much more generality than a study of icebreaker noise and is paying off with software that should be invaluable for setting up marine parks etc., where noise interference really could be an important issue. Especially from whale watching boats.

Contact: Patrice St-Pierre (519) 383-1807
Project Number: FRCU4

Development of Centre Line GPS Way Points Simpson Straits into Cambridge

The Canadian Coast Guard (CCG), Marine aids to navigation service, is investigating discontinuity in navigational information arising out of program funding reductions for floating aids in the Western Arctic. Clients have expressed concern with respect to their requirement for floating aids to navigation in the Central Arctic, mainly, at Cambridge Bay, through Simpson Straits and into Spence Bay and Gjoa Haven. It is CCG's Central and Arctic's view that the removal of floating aids to navigation is possible, with upgrades to fixed aids in the area.

This year's project included conducting surveys and collecting data for New charting and NAD 83 Way Points in support of DGPS Navigation in Simpson Strait, Northwest Territories. The Canadian Hydrographic Services Central & Arctic Region provided project execution. Presentation at the Canadian Marine Advisory Committee (CMAC) Northern on the subject was also well received. A report for this fiscal year was submitted by Canadian Hydrographic Survey with work to continue into 2000-2001.

Contact: Patrice St-Pierre (519) 383-1807
Project Number: FRCV4

Modular Shipboard Water Treatment System II

A polishing biological sewage accumulator has been installed on the CCGS Griffon to deal with black water. A number of design changes and protocols were established with this vessel. The results are extremely encouraging.

The Canadian Coast Guard intends to further develop this technology to improve the system for treatment of greywater and oily water separator discharge ranging from 15 to 30 PPM.

This year's Phase Two project consisted of building two units for 25 man capacity which were installed on the CCGS Dumit and Nahidik. The design and construction of the Treatment plant for the CCGS Eckaloo was completed as was the modification to the primary system of the CCGS Griffon which was also tested. Improvement to reduce maintenance is underway.

The commissioning of the CCGS Dumit has been finalized and the planning to introduce the bilge water to the plant is now proceeding.

Contact: Patrice St-Pierre (519) 383-1807
Project Number: FRCW4

Small Ultra Light Weight Generator Set Phase III

The objective of this project was to produce a small light weight generator set which would meet the requirements of DND and Search and Rescue and to also provide the opportunity for scientists in the field to power their electronic equipment.

In phase I, it was demonstrated that a small light weight two stroke engine could be operated effectively. The fuel consumption although was higher than expected but 25% lower than comparative existing engines. In phase II, the lower specific fuel consumption was lowered by 30%. It was recommended that a prototype generator set be demonstrated in the field.

Phase III saw the design and building of the AVERO diesel powered generator set which are light weight, compact, fuel efficient and extremely rugged. These small, Polar-Lite Canadian developed generator sets are designed for Arctic winter conditions. They are the only diesel generator set that can be left exposed to Arctic winter conditions for several months and then be hand started at temperatures down to –46 degrees Celsius without any battery assistance or flammable/volatile starting fluids. This system is based on AET's patented low temperature starting aid (LTSA). The generator set can be used for search and rescue operations, since its operation with diesel fuel permits it to be flown safely. With the AET patented intake air heating system (IAHS) these diesel engine driven generator sets produce significantly lower unburned hydrocarbons and particulate emissions than other small, air cooled, diesel engines.

The design of the exhaust manifold and the installation of the Governor is completed. The testing will be carried out in the next few months.

Contact: Patrice St-Pierre (519) 383-1807
Project Number: FRCY4

Biological Degradation of Bulk Oil

Disposal of waste oil is very difficult in remote areas. This project's intent was to invite Industry and other Government Services to actively participate in solving the problems associated with waste oil handling and disposal.

This technology will appeal to those organizations who have large amounts of bulk oil for which there is no current alternatives to proper disposal other than expensive transportation to fixed treatment sites.

Unfortunately, due to unforeseen circumstances, this year's project did not proceed according to plan. Trials however will be initiated in 2000-2001.

Contact: Patrice St-Pierre (519) 383-1807
Project Number: FRDD4

Monitoring System for 150 to 400 kw Diesel Alternator Engine

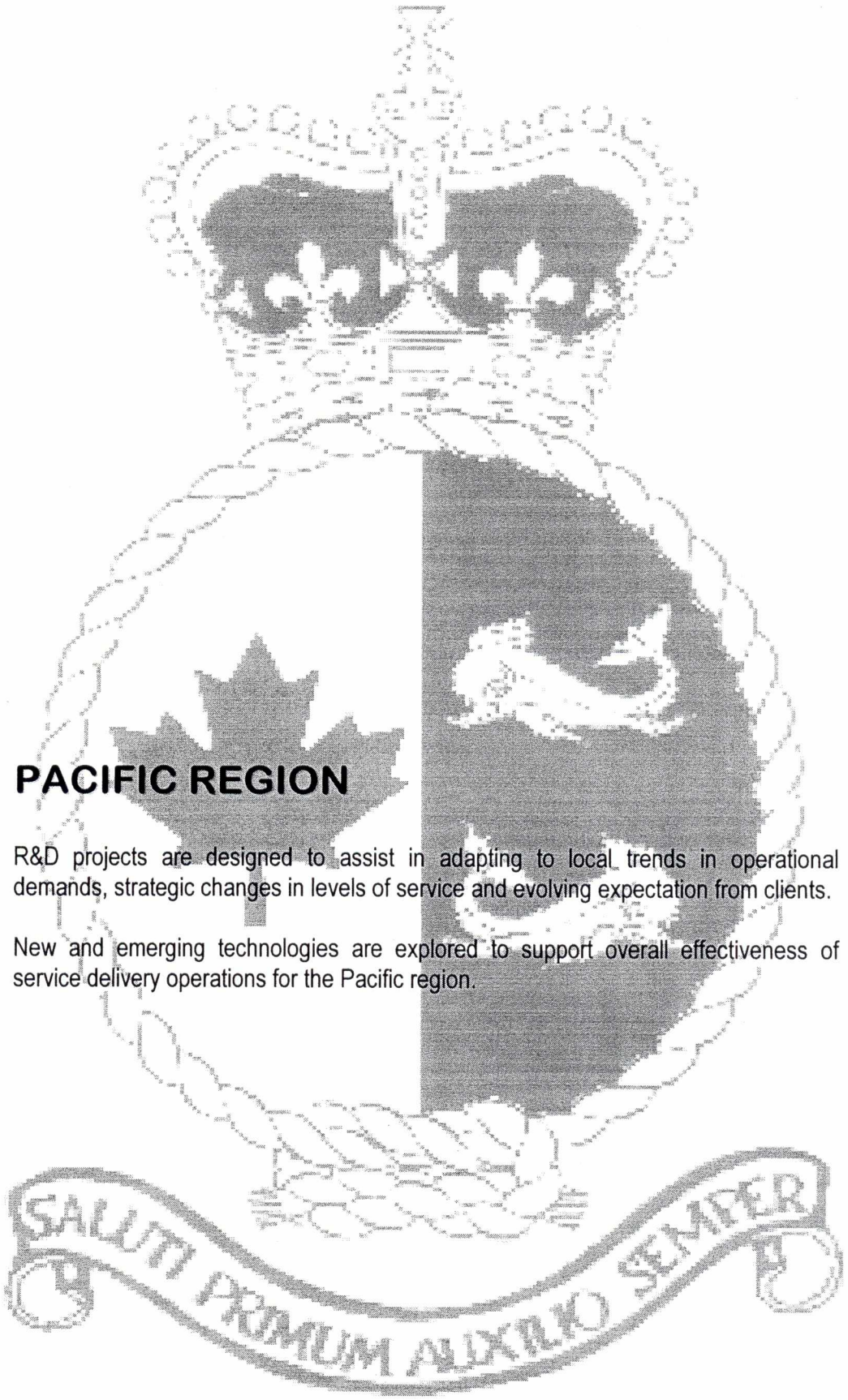
Diesel engines are frequently used to generate electrical and mechanical power in locations where loss of power would have serious safety or cost implications. Cost driven efficiency improvements have led to increased numbers of diesel engine installations operating with reduced levels of human supervision. At unmanned or infrequently manned locations, preventative maintenance is often scheduled with little knowledge of the performance of the engines or the actual repairs required, resulting in higher costs. Such maintenance practices are often implemented for diesel engines used in both stationary and transportation applications.

Advanced Engine Technology Ltd. (AET) has developed the Engine Condition Monitoring System (ECM) which is a fully automated engine health monitoring system which can detect cylinder faults and predict the relative power output of each cylinder without measuring cylinder pressure. This system has been developed by AET based on the Instantaneous Crankshaft Velocity (ICAV) technology, initially developed and patented by the National Research Council Canada. This technology predicts the power output of each cylinder from accurate measurements of the periodic fluctuations in crankshaft velocity, as each cylinder undergoes compression and expansion.

The Portable Pressure Tool (PPT) provides measurement, analysis and storage of cylinder pressure and injection pressure waveforms for engines equipped with permanently installed cylinder pressure ports. Both the ECM and PPT will provide operators the information needed to quickly and easily assess engine health. The ECM continually monitors engine performance and can automatically alarm operators of problems, which affect individual cylinder power output.

This project was not able to proceed as planned but is now intended for 2001-2002.

Contact: Patrice St-Pierre (519) 383-1807
Project Number: FRDB4



PACIFIC REGION

R&D projects are designed to assist in adapting to local trends in operational demands, strategic changes in levels of service and evolving expectation from clients.

New and emerging technologies are explored to support overall effectiveness of service delivery operations for the Pacific region.

Research & Development Plan
Year-End Budget Summary
1999-2000

PROJECT CODE	PROJECT TITLE	FUND SOURCE	1999/2000 FUNDS	
			CCG	PARTNER
FPAE5	Tracking Video	CCG	19.3	
FPAF5	Vessel Traffic Operations Support System (VTOSS) - Web Application	CCG	29	
FPAG5	VTOSS - GIS Database Interface	CCG	5.7	
FPAH5	Dangerous Goods Information Model	CCG	60	
FPAJ5	Mountaintop Cameras	CCG	12.9	
Pacific Region - TOTAL		CCG	126.9	

Tracking Video

The Canadian Coast Guard's (CCG) Marine Communications & Traffic Services requires visual surveillance of vessels, which is provided in some areas by video cameras. The broadband communications links to these cameras can be costly, and prohibit implementation in areas which would be operationally beneficial. The pending relocation of KAP100 MCTS Centre to Harbour Centre will create additional video demands and additional communication problems for existing video.

This project is still in progress. For further inquiries, please contact the undersigned.

Contact: Andy Hellqvist (604) 775-8845
Project Number: FPAE5

Vessel Traffic Operations Support System (VTOSS)

VTOSS is a collection of software elements created as an aid to marine traffic regulation and marine information processing. To date, development efforts have been geared towards producing a more comprehensive system for use in the MCTS operations by automating processes and creating databases to make existing tasks and services more efficient. As more of MCTS's services became dependent on VTOSS, so did the clients depending on these services. External clients became an increasing consideration in the development process. Thus, the latest development direction is focused on external expansion: creating a client-server system allowing external clients to access, and in some cases, modify VTOSS information. This new direction is the nucleus of another relatively new idea within VTOSS development: cost-recovery. Those client-server services that provide information gratis will now be user-pay services.

The project was actually budgeted for 99/00. However surplus funds became available at the end of FY 98/99. The majority of the computer software was purchased with this advanced funding, as it would accelerate the project start up time. The associated hardware and other costs were procured during the second year.

This project is now complete. The web browser software was developed in-house and is now working as anticipated. A copy of the software (about 900Kb) can be forwarded via email if anyone is interested in actually seeing the end product. This program will work on any computer connected to the Internet.

This software has been distributed to a few selected individuals (within the Government only) for testing purposes at this time. It is planned to allow outside users access in the near future.

There are no on-going costs and it is anticipated after this testing period that we will allow commercial users access with password control. It is further planned to charge for this privilege and pro-rate costs depending on their individual requirements.

Contact: Andy Nelson (604) 775-8869
Project Number: FPAF5

VTOSS – GIS Database Interface

VTOSS (Vessel Traffic Operations Support System) is a collection of software elements created as an aid to marine traffic regulation and marine information processing. Development efforts to date have been to produce a more comprehensive system for use in the MCTS operations-automating processes and creating databases to make existing tasks and services faster and easier. As more of the MCTS services grew dependent on VTOSS, so did the clients depending on these services. External clients became an increasing consideration in the development process. Thus the latest of these directions is geared towards external expansion-creating a client-server system allowing external clients to access, and in some cases, modify VTOSS information. This new direction will be combined with another relatively new idea within VTOSS development : cost recovery. Those client-server services that provide information would not do so for free.

As noted in item 6 below, this project funding was spread over a two-year period. The equipment (file servers) was purchased during the 1st FY period. The software and its installation were the two main products of the 2nd FY time frame.

This project is now complete and there are no on-going costs associated with this proposal.

The VTOSS program is now in operation at 4 of our 5 MCTS Centres. The last Centre has all the hardware and software required to run the program. Due to a longer than anticipated learning curve the complete program will not be installed at this last Centre until the Fall. There are no external costs associated with its installation.

In addition to the GIS and database functions this program has eliminated the use of paper strips completely. Handoffs of traffic information on vessels between Centres and Sectors are now completely electronic.

Contact: Andy Nelson (604) 775-8869
Project Number: FPAG5

Dangerous Goods Information Model

Presently the Port of Vancouver runs a computer program known as PortView. The program incorporates a GIS mapping function to visually depict the Port of Vancouver, and the location of vessels at the various berths and anchorage's. The map is a vector format map.

This program is used by CCG MCTS Vancouver to assist them in their duties of Vessel Traffic Services at the Marine Information Centre. It lets the user see the attributes of each ship, such as: the anchorage or berth, what it is loading or unloading, when it arrived and is due to sail, the agent that is dealing with the ship, the ships' call sign, flag, and the number of passengers on cruise ships.

The Port of Vancouver proposes to include a new field to the program, that being dangerous goods. They propose that they would work closely with CCG to develop this field so as to include the information we foresee as needing for Environmental Response (ER) purposes. CCG ER would ensure the information that will be gathered both meets the response needs, and meets international standards.

We are presently working with CCG-ER in Ottawa in developing the MCER regime. We feel that this new field will go a long way in assisting the responder to a dangerous goods response. As the field is developed we would ensure CCG - ER in Ottawa is satisfied that the information will meet the goals of the new regime.

The R&D project was completed on time and on budget. The Dangerous Goods reporting system as part of Port Vancouver's PortView system is running successfully. All ships importing or exporting dangerous goods now receive clearances through the internet from the Port of Vancouver for the port. CCG-MCTS can track the permit approvals at the Regional Marine Information Centre.

In fact it has been so successfully we are now working with The Port of Vancouver to use this basic system at all West Coast ports.

Contact: Bill Dutrizac (604) 270-3106
Project Number: FPAH5

Mountaintop Cameras

The Canadian Coast (CCG) Guard Pacific region has a number of mountaintop sites that are only accessible by helicopter. Flight time to some sites can be a number of hours. On many occasions the top of the mountain may be clouded in on an otherwise sunny day and therefore the trip has been wasted, as it is not possible to land.

This project is still in progress with the final report due in 2000-2001. For further inquiries, please contact the undersigned.

Contact: Rick Chemoff (604) 775-8858
Project Number: FPAJ5

FINANCIAL SUMMARY

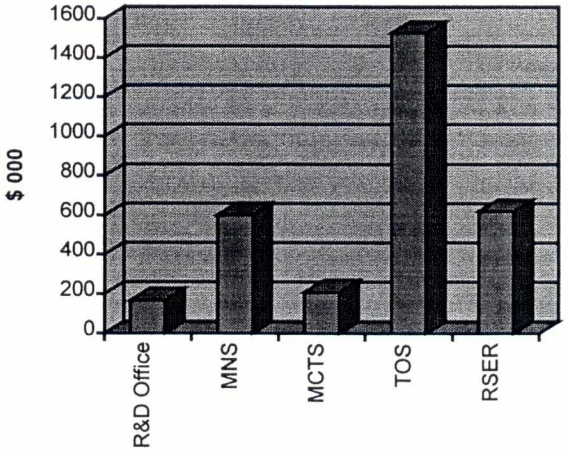
R&D Program Funding

The Canadian Coast Guard (CCG) R&D Program includes projects conducted solely by CCG and projects carried out in partnership with other governments, agencies and industry. Funding sources for CCG's R&D "partnership" program varies for each project. Total funding is occasionally obtained from outside sources.

The total value of the CCG R&D program in 1999-2000 was $3.5M. This does not include the invaluable "in kind" support received from many agencies and departments.

In addition to this R&D Program, CCG branches and regions conduct extensive test and evaluation studies that often contribute to the development of new technologies and assist CCG in fulfilling its mission. These projects are not included in this report. Costs are recovered from the Branch or Regional operations budgets.

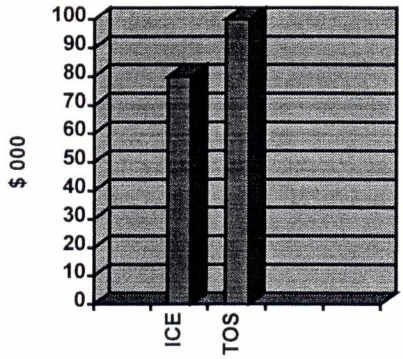
CCG R&D Budget 1999-2000



Program for Energy Research and Development (PERD)

Program for Energy Research and Development (PERD) is the principal supporter of energy science and technology in Canada. In fulfilling its objective, the Program supports the development of environmentally and economically sustainable energy production and diverse end-use technologies which promote the competitiveness of industries in all regions of Canada. It also provides a technical basis for codes, standards and regulations.

1999-2000 CCG PERD Funding



PERD funding plays a key role in Canadian Coast Guard's R&D Program. Many of Coast Guard's R&D efforts are jointly funded by PERD which is administered by Natural Resources Canada - Office of Energy R&D. The PERD funds were committed to high priority "energy-related" projects which effectively served the CCG's operational mandate. Annually, the CCG submits proposals to PERD in the fall for review.

CCG's source of PERD funds is from PERD's transportation component. The aim is to improve fuel efficiency and reduce emissions in shipping. It also will support the development of standards that ensure the safe operation of the marine fleet. The key areas of work included developing better methodologies for vessel routing, developing the capability to predict environmental information to improve fleet efficiency and performing the R&D necessary to create standards to improve the efficiency of navigation systems and ship propulsion systems.

The PERD partnership contribution to CCG's R&D program in 1999-2000 was $180K.

FINANCIAL SUMMARY

Transportation Development Centre (TDC)

Transportation Development Centre, TDC, is operated by Transport Canada in support of R&D in transportation technology. TDC and CCG often work together, and like the Coast Guard, TDC works with other federal departments, provinces, industries and universities.

In the CCG R&D program, TDC focuses on high-risk, medium and long-range transportation R&D projects. TDC also participates with CCG in managing and funding many of CCG's mission-oriented R&D projects, and CCG utilizes the services of TDC to contract-out many of its R&D projects to various private and public sector organizations.

The close cooperation between CCG and TDC enhances the development of marine transportation and technology and assists CCG in meeting its operational and regulatory mandates. TDC's contribution to CCG's R&D projects in 1999-2000 was $180K.

Other Partnerships

Partnerships with industry are highly valued and the new legislation regarding Intellectual Property ownership is expected to influence CCG's R&D program in a positive manner. Partnerships with industry are conducive to the development of new products and services applicable to CCG operations. Industry-partnered projects help Canada maintain its role as a world leader in marine research and development.