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17. Abstract

The Canadian Coast Guard Research and Development Plan lists those research projects planned for fiscal year 2003-2004 by the various branches and regions.

The Plan currently has several priorities. The development of technical solutions to its navigation services and exploring the development of a new orientation to the marine electronic highway, which is focused on using information-based services, is one area recognized as offering significant opportunities.

As well, the promotion of sustainable transportation, or safety of the environment, by minimizing the marine footprint on the world's oceans is a major theme. The CCG is currently developing applications for biologically-based sewage treatment plants on its ships and the improved maintenance/operation of ship's engines.

A third area of concern is recreational boating safety issues. The CCG is reviewing the usage rates of personal floatation devices and initiating further studies into fishing vessel safety, in conjunction with Transport Canada and Fisheries & Oceans.

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Research and Development Plan 2003-2004

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FOREWORD

Research and Development (R&D) is an essential element in the Canadian Coast Guard's strategies to achieve its operational mandate. The Coast Guard is dedicated to ensuring the safe and environmentally responsible use of Canada's waters. Research and Development is one way in which the Coast Guard seeks to become more efficient in its day-to-day operations as well as improving the effectiveness and appropriateness of its levels of service.

Coast Guard will fund a $3.5 million dollar R&D program in the 2003-2004 fiscal year. Additional funds will be provided by industry and international partners.

The CCG R&D plan supports the Coast Guard's strategic plan. R&D performed today provides marine expertise in order to influence international standards and to support Canadian industry for the future. Coast Guard research is dedicated to resolving those technology challenges brought-on by the changing nature of commerce worldwide and the evolution of the marine community.

As part of its commitment to the economy and the achievement of Canada's goals, the Canadian Coast Guard continues to offer a broad-based planning process involving not only its own staff but also its clients. Likewise the Coast Guard will continue to work and consult closely with Canadian industry, universities and colleges seeking partnerships in knowledge wherever practical. Also the R&D program is closely integrated with the work of other government departments and foreign countries.

Any questions or suggestions regarding this publication should be directed to the Manager, Research and Development, (613) 990-3087.

LOOKING TO THE FUTURE

The R&D program has a long and valued history in the Canadian Coast Guard (CCG). The program was initiated in 1974 in order to meet new CCG operational demands, using technology as one of the primary tools of change. The decision to put an R&D (engineering) program in place was recognized as one of the several mechanisms required to keep the organization forward looking and to respond to challenges in service delivery and efficiency. Today, the adoption of new technologies to meet the challenges of a changing environment remains one of the Coast Guard's four organizational pillars for modernization and growth.

Subsequent to the 1995 merger with the Department of Fisheries and Oceans (DFO), a new series of strategic directions and operational goals were enunciated, to bring the Coast Guard into line with government wide business planning practices. As well, the department's new strategic directions placed emphasis on organizational evolution from a broad-based service delivery group to a more finely-tuned organization exercising leadership and knowledge management. Today, the CCG's leadership role is more broadly understood by industry and other members of the marine community; the evolution of government services to permit a more inclusive role is seen as an effective means of involving interested parties, reducing overall costs, and meeting new challenges for services. Within this organizational context, the issues of safety, environmental protection and support to marine commerce remain as the operational pillars and play determining roles in our capital and operational planning.

CCG's mission is to ensure the safe and environmentally responsible use of Canada's waterways, to support understanding and management of ocean resources, to facilitate the use of our waters for shipping, recreation and fishing, and to provide marine expertise in support of Canada's domestic and international interests.

CCG research addresses a wide range of technological issues brought-on by changing trends in the marine world and international transportation markets; changes in demand for marine services; and to new strategic directions defined by the government. R&D is also directed to a strategic understanding of the broader marine environment, the footprint left by marine activities on our oceans and freshwater resources, and to sustainable transportation objectives. Finally, the R&D program assists in meeting new management strategies relating to changes in levels of service and client advice on the marine program.

The CCG research activity also complements the departmental ocean strategies by supporting a shared knowledge base in theme areas of mutual or overlapping interest.

A wide range of strategies are used to achieve the CCG R&D program goals, including (but not limited to) contracting-out; intellectual property (IP) management; technology transfer through partnerships with other departments, agencies, industry and/or universities; involvement in the government's innovation initiative; the marketing of public service expertise; and international cooperation.

The Coast Guard R&D Program is coordinated through one focal point to assist in the establishment of a master plan, support to the CG business plan and to facilitate the establishment of priorities, project selection criteria, performance measures, reporting and accounting.

At this time, Coast Guard has several priorities. The evolution of its navigation services and the development of a new orientation to the marine electronic highway, which is focused on using information-based services, is one area recognized as offering significant opportunities. As well, the promotion of sustainable transportation, including the safety of the environment by minimizing the marine footprint on the world's oceans, is a major theme. A third area of concern is recreational and boating safety issues. Traditional priorities, which include safety of life, operational efficiency, and support to the domestic marine industry also, remain strong. Within the area of energy and emissions, the CG is moving to new strategies for engine health monitoring, fuel conditioning and fuel management. The CG will explore these and other opportunities by sponsoring R&D.

In summary, R&D sponsored work will focus on the following:

Marine Highway:

- development of advanced navigational and ship-related telecommunications and information systems (often satellite-based);
- automatic processing, analysis and automated transmittal of remotely-sensed ice information;
- adoption of AIS and development of alternative technologies to the current physical navigational aid infrastructure;
- presentation of information to the navigator both logically, and in a compatible manner/languages;
- interactive nature of displays on the bridge of the vessel;
- integration of ship's information with shore-side traffic management and commercial shipping operations;
- electronic devices which automatically monitor vessel position and/or services to home-in on persons in the water.

Sustainable Transportation, Environmental Protection and Safety:

- development of improved regulation, standards, training and certification procedures for small craft operators;
- research into new engine maintenance management systems, novel power systems/components, and emission control technologies which offer greater efficiency, reduced emissions and reduced maintenance;
- development of "biological" sewage treatment facilities for ships, to handle black and gray water, with zero tolerance regimes as a target.
- development of new technologies which will lead to the mitigation of clean-up costs and due diligence in environmental matters.

Boating Safety/Others:

- increased wearing of personal floatation devices;

- risk management strategies;
- occupational safety and health.

Annually, CG will plan and prioritize R&D projects based on the above key thrust areas to give CG the information it needs to make prudent and strategic investments to provide effective and efficient public services.

Marine Programs

The Marine Programs (MP) Directorate was created in April 2000 as a result of HQ Renewal. It is one of four Directorates within the CCG and encompasses four Branches and an Administrative Services Group, namely Planning and Performance Measurement, Policy and Legislation, Navigation Systems, and Safety and Environmental Response Systems. The R&D projects presented by these groups address the challenges and opportunities identified as essential to meet client demands and changing program structures, policies and levels of service.

Project List Summary

PROJECT NUMBER	PROJECT TITLE	2003/04 (approved)	COMMENT
CG R&D OFFICE			
FRCV6	R&D Workshop	15	
	CG R&D Office – Total	15	
RISK MANAGEMENT			
FKDE6	Marine Activity Geomatics and Risk Analysis in the Coastal Zone	80	
	Risk Management – Total	80	
SAFETY & ENVIRONMENTAL RESPONSE SYSTEMS – Office of Boating Safety			
FKCT6	Research Project for Increased Wearing of Personal Flotation Devices (PFD)	225	Funds to be transferred to Newfoundland.
	Office of Boating Safety – Total	225	
	– Search and Rescue		
FKDH6	Search Planning Validation	60	
	Search and Rescue – Total	60	
	- Emergency Response		
FKCA6	Development of Response Strategies for Ori-mulsion/Heavy Oils	285	Funds to be transferred to Maritimes.
	Emergency Response – Total	285	
	- Marine Communications & Traffic Services (MCTS)		
FKAH6	Frame Relay Trial		Tasked to ITS. See ITS for project description.
New	Feasibility Study to Assess the Potential of Fuel Cell Power Generator for Telecommunications Tower Equipment	45	

PROJECT NUMBER	PROJECT TITLE	2003/04 (approved)	COMMENT
	MCTS – Total	45	

Project List Summary
(Continued)

PROJECT NUMBER	PROJECT TITLE	2003/04 (approved)	COMMENT
MARINE NAVIGATION SERVICES - Aids to Navigation			
New	Development of Laser Range Light – Phase II	75	
New	Automatic Identification System (AIS) for Aids to Navigation	100	
FKAB6	Lighted Plastic Buoy Development	150	
FKAD6	Long Life Synthetic Mooring	50	
FKAG6	Visual & Radar Ranges for Steel & Plastic Buoys		Tasked to ITS. See ITS for project description.
FKAE6	Evaluation of Large Electric Double-layer Capacitors for Powering Aids to Navigation		Tasked to ITS. See ITS for project description
	Aids to Navigation - Total	375	
MARINE NAVIGATION SERVICES - Icebreaking Program			
FTPA6	Cross-Polarized Radar Trials	50	
	Icebreaking – Total	50	

CG R&D Office

This office, located within the Planning and Performance Measurement Branch, 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.

R&D Workshop

Looking to the future, the CCG is facing significant challenges … economic adjustments, shrinking budgets and downsizing. The adoption of technological innovations is one means of addressing levels of service and financial issues. The development and adoption of new technologies specific to the CCG needs (and beneficial to the marine/oceans community) requires a strong focus and consensus on how the future will unfold. All interested players must agree in the most probable directions.

To ensure CCG research work is closely linked to the CCG 2010 strategic directions and the views of industry, a workshop is proposed to review and discuss future trends in technology. Much of the effort is expected to focus on exploiting existing and planned marine technology and equipment needed to meet mission requirements.

The pressing challenge for CCG is in navigation issues followed by environmental and the traditional safety issues. For example, some issues of concern include automatic vessel identification (AIS), fuel conditioning and fuel (purchase) management strategies, management of ice on the St. Lawrence River, and geomatics.

The results from this project will establish a guide to where CCG should be investing in R&D that will contribute to our future requirements.

Contact: Wayne Ellwood, (613) 990-308 *Project Number: FRCV6*

Risk Management

The Risk Management office falls within the Policy and Legislation branch. Their function is to institute a "risk-based decision assistance tool" that will roll-up/correlate present data in a way that is useful and meaningful to employees. This function will also monitor the application of an appropriate risk management approach that supports program decisions across the CCG sector.

Marine Activity Geomatics and Risk Analysis in the Coastal Zone

There is a need for a marine risk model that can predict incident loads by location, activity type, and time-of-year by isolating significant risk factors, including uncertainty measures in the estimates of frequency of occurrence, and weighting consequences for each class of incidents. A risk model and GIS software, which respond to these requirements, have been

deemed by CCG SAR to be essential tools in SAR Program management and effectiveness.

The project is developing a comprehensive marine activity and risk model to address Canadian Coast Guard planning issues and to serve as an important component of coastal mapping. The major thrusts area: data management, spatial analyses, risk modelling, and decision models. The basic framework for a general risk model has been well developed. Researchers have developed and upgraded programs and menus based on user requirements. Further data collection and testing of decision models to marine analysis is underway. Plans are to deploy the model at CG stations across Canada. Training as well as the publication of a users' manual will be the final tasks of the projects.

A comprehensive marine risk model would be very useful for Coast Guard planning for Search and Rescue. More lives may be saved by providing sound analytical information for the effective deployment of SAR resources in regards to marine activities and risks. It could also be applied for accident prevention activities, congestion evaluations, and oil spill response. The results of this work will also serve as major components of a broader generic coastal mapping model.

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

Safety & Environmental Response Systems Branch

This branch conducts R&D projects for the promotion of boating safety, environmental response, search and rescue and marine communications and traffic services. Emerging technologies and innovative techniques are tested and evaluated for these respective program areas.

Office of Boating Safety

Research Project for Increased Wearing of Personal Flotation Devices (PFD)

Recreational boating is a fast growing and popular leisure activity in Canada. There have been significant changes to the regulatory framework governing recreational boating safety in Canada. In addition, there are major non-regulatory initiatives underway within the Office of Boating Safety (OBS) to address concerns with Canadian recreational boating safety. A substantial effort has been directed towards making Canadian waters as safe as possible for everyone. For example the passing of the *Competency of Operators of Pleasure Craft Regulations*, *Age and Horsepower Restrictions*, the amendments to the *Small Vessel Regulations*, as well as a more highly visible *Enforcement Program* on the water will lead to an increased awareness of boating safety issues by industry, boating organizations and the boating public. These initiatives and the regulatory changes are expected, for example, to increase compliance with the safety equipment carriage requirements of the *Small Vessel Regulations*.

This project was initiated to develop a level of knowledge about the current boater population, themes and messages that will have a positive effect on boater attitudes. Over 6 years, OBS has worked with behavioural change and social marketing consultants to explore research options to determine strategies to increase PFD wear in any circumstance in Canada.

This is the final stage of this multi-year project. It will involve a careful analysis of the research and data to date to develop a three to five year communications plan to deliver the most appropriate messages through the most effective methods to increase wearing of PFDs among Canadian recreational boaters.

If the analysis of the research and data suggests there is a need to develop regionally-tailored communications plans, these will also be included.

To ensure success of the communication plan, at least two waves of focus group testing will be conducted to evaluate options and to test final copy. These focus tests are planned to be carried out in three languages (English, French and Inuktitut) by the Office of Boating Safety.

Further research will be conducted as necessary into various aspects of boaters' decision-making process regarding PFD wear, such as boaters perception of risk and how that affects PFD wear.

A final presentation and report of research findings will be produced. This will be presented at two international conferences on safe boating (SARScene, and Boating and Water Safety Summit).

A PFD safety information video will also be produced in partnership with Memorial University of Newfoundland's Centre for Academic and Media Services.

The ultimate benefits from this project for CG is reducing the time, cost, number and severity of SAR cases. As well, it will assist OBS and other boating safety stakeholders to deliver the most appropriate messages through the most effective methods to increase wearing of PFDs among Canadian recreational boaters.

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

Environmental Response

Development of Response Strategies for Orimulsion/Heavy Oils

As new petroleum products are introduced into Canada, both the Canadian Coast Guard (CCG) and industry must strive to continuously improve their ability to respond to spills of these new products. Orimulsion is a new petroleum product that presents new challenges for response.

Orimulsion is a heavy bitumen that has a higher viscosity than Bunker C, sinks in freshwater and floats, semi-emerged in salt water. Due to the unusual behaviour of this product, response agencies are struggling to find ways of recovering Orimulsion in the marine environment.

This project is set out in a multiyear workplan and addresses 5 subject areas: shoreline recovery, mechanical recovery, biological studies, chemical/physical studies and detection and tracking. Proposals from government and private organizations have been submitted to CCG which have been classified and prioritized under the 5 subject areas. Researchers are gathering valuable information from the projects undertaken to date. The knowledge generated by these studies will be invaluable for persons involved in spill countermeasure decisions and regulatory formulation.

The resulting information will benefit CCG, Response Organizations (RO's) and Oil Handling Facilities (OHF's) through improved response strategies to reduce the amount of time and effort spent on recovering Orimulsion and heavy fuel oils and employing newly developed equipment which will improve the efficiency and effectiveness of response operations, thus reducing response costs and ensure a clean and healthy environment.

Contact: Ron MacKay, (902) 368-0204 *Project Number: FKCA6*

Marine Communications and Traffic Services

Feasibility Study to Assess the Potential of Fuel Cell Power Generator for Telecommunications Tower Equipment

Currently many telecommunications towers are powered by diesel generator systems and have the potential of being replaced by Fuel Cells as a power generator either as a stand alone source or coupled with other power sources such as photovoltaic and/or wind generators. CCG investigated Fuel Cell technology a decade ago and found it to be insufficiently developed. Fuel Cells are currently developing fast as a result of the large financial investments made by the major auto manufacturers worldwide in countries like the USA, Germany and Japan. The Canadian industry has been very active in the Fuel Cell and Reformer technologies.

The Fuel Cells convert hydrogen into electrical energy whereas a Reformer converts hydrocarbon molecules into hydrogen. In the last 5-year period, Fuel Cells have increased performance by a factor of 10 while cost has decreased by 10 (source: Scientific American October 2002). The Web site of Ballard indicates that a stationary Fuel Cell generator will be marketed in Japan (using their Fuel Cells) for domestic use this year, and that a small Fuel Cell generator will be marketed by Canadian Tire and introduced in 2002/2003.

This project will study the feasibility of replacing a diesel generator system with a Fuel Cell system. The study will identify potential suppliers, document a typical site requirement and provide a comparison of the fuel cells available. A final report will make recommendations toward future implementation plans for the CCG and how it supports the Kyoto Protocol for sustainable development and environmentally friendly technology.

This initiative has the potential for MCTS to provide services at lower operating and maintenance costs.

Contact: Michel Desparois, (613) 990-3031 *Project Number: new*

Search and Rescue

Search Planning Validation

The detection of small objects at sea has always been a subject of great concern to CCG SAR. The complexity of this operation is augmented by the fact that the drift for common SAR objects is difficult to predict.

In order to establish the drift of a SAR object, CCG utilises a computerised search and rescue program called "CANSARP", and the USCG utilises a similar program, called "CASP". Both organisations are interested in validating the accuracy of the current search planning methods.

Validation of CANSARP is a complex and on-going process. It involves not only testing the actual software to determine that it operates as expected but it also includes:

- a problem reporting process to track anomalies;
- planning on-going validation activities to take advantage of sea trials or tests that deploy drifters to test models and drift prediction;
- managing specific validation tests and analysis performed by a contractor;
- supply programmer support for the contractor's specific test software requirements; and
- provide feedback to project designed to improve our ability to predict search area.

Working with Dalhousie University, testing and validation of the model continues. A number of drift scenarios will be generated and a statistical comparison made.

The CANSARP 4 validation will allow the Search and Rescue Coordinators to use the tool more confidently and efficiently to address the safety of mariners and potentially increase response time to a marine incident. More precise validation of SAR drift and planning models will increase the ability to save more lives.

Contact: Jean Maillette, (902) 564-3660 (ext 1342) *Project Number: FKDH6*

Marine Navigation Services

This directorate conducts R&D to support a safe, efficient and accessible waterway by improving operational performance of aids to navigation; reducing maintenance costs and ship-time usage in servicing of short- and long-range aids to navigation; and improving water flow models and water level prediction capability. This directorate also supports icebreaking activities through improved technologies and effectiveness in delivering icebreaking and ice-routing services, thereby enhancing the safety of ice navigation and providing support to marine transportation and to the economy in general.

Aids to Navigation

Development of a Laser Range Light – Phase 2

In phase 1 in the development of a laser range light, the Canadian Coast Guard (CCG) tried to reduce costs by developing a two-colour laser range light. It was planned that the color seen by the mariners would provide the mariner with the port and starboard deviation from the center of the channel. This would eliminate the need for the two towers required in a conventional range site. After 3 prototypes and seven years of trials, the results did not provide the mariner with accurate lateral coding which would indicate to the mariner where he was in the channel.

Phase 2 will build upon the information learned from phase 1 and develop a simple one-colour laser light to use in place of conventional range lights. It is proposed to develop a performance specification listing the minimum requirements the CCG expects from such a laser and what test it must pass in order to meet those requirements. A contract will

then be arranged with a contractor to design and build two prototype laser lights. These lights will then be installed at St-Basile, the location of the previous experiment to field test them and obtain user comments.

The advantages of this laser light would be greater range, lower power consumption and better visibility against background lighting. This would make it possible to provide the required level of service (75% of time during the worst months of the year) in areas where it is presently not possible with existing technologies. A second advantage is the development of equipment which requires less power allowing them to be solarized.

Contact: Reiner Silberhorn, (613) 998-1441 *Project Number: new*

Automatic Identification System for Aids to Navigation

Automatic Identification System (AIS) is a shipboard transponder system that is capable of automatically sending information to other ships and shore based stations. AIS is designed to improve marine safety and efficiency by: providing the mariner with important additional navigation information; simplifying information exchange between ships and between the ship and the shore; and reducing the mandatory ship verbal reporting to Vessel Traffic Service (VTS) Centres.

When fitted to selected aids to navigation, AIS can improve marine safety and efficiency by:

- Providing ships with real-time environmental data such as tide, current and visibility information.
- In addition, the authority responsible for the operation and maintenance of these buoys and beacons will be kept informed at all times of the status from its AIS-equipped aids, and will be alerted in the event of any discrepancy, such as light failure or if the aid is off position.
- AIS equipped buoys and beacons will automatically appear on AIS-enabled electronic chart systems on ships' bridges and VTS centres.

The new IMO requirements for ships to carry AIS transponders is already starting a revolution in ship-to-ship and ship-to-shore information exchange. There is no doubt that AIS will enhance safety at sea, the efficiency of navigation and the protection of the marine environment. With the implementation of AIS as a supplement to existing navigational systems on board ships, there will be a significant impact on the Canadian Marine Industry over the next few years in addition to the way in which CCG services are provided.

This project proposes to test two AIS units on buoys in the Halifax area where the infrastructure already exists to monitor them. The AIS units will provide information on the location of the aids as well as monitor the health of the navigation equipment on the buoy.

With the assistance of AIS, the number of buoys lost each year could be greatly reduced. Buoys can be remotely monitored for their position and performance of the equipment. Repairs can be made quicker thereby increasing the reliability of the system and save considerable ship time.

Contact: Tony Cheung, (613) 998-1558 *Project Number: New*

Lighted Plastic Buoy Development

One of the objectives of the Marine Aids Modernization Project is to develop a buoy system that operates without servicing or maintenance, for a period up to five years. This includes all components of the aids to navigation buoy system: hull materials, paints, moorings, power supplies, lanterns and sound signals. The main benefit resulting from the implementation of a year-round buoy equipment system is in the reduction of ship time required to service and transport buoys. Savings also result from a reduced requirement for servicing and refurbishing of buoys at CCG bases. As a result several research initiatives are underway.

In 1990, the CCG began investigating the use of plastics as a potential replacement material for the steel predominantly used in buoy construction. Today a significant number of small unlighted plastic buoys are in service across the country. This success has yet to translate in the use of plastic buoys to replace the larger steel lighted buoys. There are many structural and strategic problems to overcome before larger plastic buoys can become a reality. Although a number of large lighted plastic buoys exist on the market, further testing and evaluations are required to develop a thorough understanding of the benefits and limitations of the large lighted plastic buoys and encourage industry to meet CCG's operational specifications.

This project will be carried out in three phases. Phase 1 will develop a set of performance specifications specifying CCG's operational requirements. Phase 2 will be the development of testing specifications and procedures to help determine whether the buoys are in full compliance with the CCG performance specifications. Phase 3 will test and evaluate commercially available large lighted plastic buoys. A final report of the findings and recommendations is expected in March 2005.

Large lighted plastic buoys could bring significant savings to the CCG by eliminating the need for sandblasting and painting and servicing by large buoy tenders.

Contact: Reiner Silberhorn, (613) 998-1411 *Project Number: FKAB6*

Long Life Synthetic Mooring

Under the umbrella of the five-year buoy project is the study of synthetic mooring. There are a significant number of locations where the mooring chain does not stay on location 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.

Previous studies have looked at the reliability, safety and cost effectiveness of synthetic moorings. Although the results have raised several questions, there is a lot of potential in synthetic moorings and it is recommended that comprehensive performance specifications be developed before any further testing is undertaken.

As a result, this year the project will develop a comprehensive performance standard/specification detailing all CCG requirements in a synthetic mooring system.

The requirements will include design, handling and safety concerns. In the following year, work will continue to finalize the actual mooring based on the requirements of the specification.

Synthetic moorings can save money and ship time for the CCG. They are also environmentally friendly as they cause less sea bottom disturbance compared to chain moorings.

Contact: Reiner Silberhorn, (613) 998-1411 *Project Number: FKAD6*

Icebreaking

Cross-polarized Radar Trials

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

During the mid 1980's cross-polarized radar was identified as a promising ice hazard detection technology at McMaster University. Since then operational systems were developed, tested, and improved to the point where the technology is now operationally viable. One of the problems facing shipping in ice infested waters is the inability of standard radar to differentiate between first year and older ice. Cross-Polarized Radar (x-pol radar) has proven to be effective, but expensive.

A commercial off-the-shelf fishing radar has been modified to develop a cross-polarized system prototype. After successful laboratory testing, the system was installed on board an icebreaker during the 2002-2003 winter navigation season. The data collected will now be analyzed and an evaluation summary prepared on the trial findings.

The availability of the X-Polarized radar technology will provide precise ice information regarding ice conditions. Better route planning and improved operational efficiency will result for CCG Icebreaking Operations and commercial operators.

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

Fleet

This directorate conducts R&D to improve cost-effectiveness and performance of the DFO fleet and the management of policies and standards for improved safety and development of seagoing personnel.

Project List Summary

PROJECTNUMBER	PROJECT TITLE	2003/04 (approved)	COMMENT
FQBK6	Hearing Standard for Seagoing Personnel	50	
FQAG6	Vision Standards for Seagoing Personnel (Physical Activity Requirements)	100	
	Fleet - Total	150	

Hearing Standard for Seagoing Personnel

In Canada, the law requires that standards for hiring, whether medical or physical fitness, be set objectively and be reasonably necessary for the efficient and economical performance of the job, without endangering the employee, their fellow employees and the general public. This is referred to as a Bona-Fide Occupational Requirement (BFOR).

In a Supreme Court decision, the Court instructed the manner in which standards are to be set. Standards are normally to be set based on researched scientific, statistical and empirical evidence. Impressionistic evidence, usually that provided by operational experts, is generally not be itself, sufficient in determining that a standard is a Bona-Fide Occupational Requirement.

As the employer, the Department, and in particular, the employing sector, is the organization required to defend any standard it uses or adopts. As the employer of ships officers and ships crew, the Coast Guard is obligated and has the desire to ensure a safe workplace, while at the same time complying with the Canadian Human Rights Act by ensuring that the medical standards are a Bona-Fide Occupational Requirement.

The University of Ottawa was contracted to study four key objectives: to identify or develop a hearing test(s) that will address speech and noise, signal alarm detection, and localization; to ensure that the test(s) are directly applicable to the CCG seagoing environment and job functions of all CCG ships' departments (logistics, engineering, deck); to validate the selected test(s) for minimal acceptable hearing standards for CCG seagoing personnel, in terms of operational relevance to crew performance and safety; and to establish minimal acceptable auditory norms using the selected test(s). The results of the research work are being prepared in a final report for presentation to CG senior management. The research will also be conducted in French to ensure fair and equitable results in both official languages.

The major benefit for CG is the establishment of a hearing standard as "Bona Fide Occupational Requirements" (BFOR) for seagoing occupations and that the standard is defendable against challenges.

Contact: Sharon Robertson, (613) 990-2573 *Project Number: FQBK6*

Vision Standards for Seagoing Personnel

This research project addresses the Bona-Fide Occupation Requirements for vision standards for seagoing personnel.

The objective is to develop minimum vision standards for high and low contrast visual acuity, colour discrimination, field of view (FOV), depth perception, visual search, and useful field of view (UFOV) for CCG seagoing personnel (officers and crew for deck, engine room and logistics departments, and Conservation and Protection seagoing Fishery Officers). Research results will be presented in a final report that will contain the recommended Vision Standard for seagoing personnel.

The establishment of a recognized Bona Fide Occupational Requirement (BFOR) vision standard will ensure a safe workplace and at the same time comply with the Canadian Human Rights Act.

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

Integrated Technical Support (ITS)

This directorate was created in April 2000 and is the technical support arm of the CG. ITS will be responsible for delivering the technical component of the R&D program on behalf of Marine Programs and the Fleet groups where technical expertise is required.

Project List Summary

PROJJECT NUMBER	PROJECT TITLE/ TITRE DE PROJET	2003/04 (approved)	COMMENT
FRBQ6	US Ship Structure Committee (membership)	45	
FQAX6	Frame Relay Trial	25	Tasked by MCTS.
FQAM6	Evaluation of Large Electric Double-layer Capacitors for Powering Aids to Navigation	200	Tasked by MNS.
A62AA	Visual and Radar Ranges for Steel and Plastic Buoys	100	Tasked by MNS.
HCAA6	Evaluation of Arctic Diesel Fuel and Marine Diesel Oil Blends with and without Lubricity Additives in Coated Injector Plungers for a Vasa 32 Diesel Test Engine	180	Tasked by Fleet.
	ITS - Total	**550**	

US Ship Structure Committee

The Ship Structure Committee (SSC) Headquarters is located in Washington, D.C. The SSC is an international agency with the mandate to further research and development in the area of ship structures. The purpose of the committee is to promote a research program to improve the hull structures of ships and other marine structures by an extension of knowledge pertaining to structural design, lifecycle risk management and production methods.

Canadian membership is comprised on the Defence Research Establishment Atlantic (DREA) (Canadian Navy); Transport Canada (TC) and Canadian Coast Guard (CCG). Canadian engineering companies are often called upon to provide expertise and perform R&D contracts for the SSC, often under direct management from participating Canadian Agencies.

The current focus of the SSC involves the rapidly changing environment for ship design. Current trends in design require concurrent engineering methods and the need to consider manufacturing and cost constraints in the early stages of design. Acquisition reform and, specifically, changes in the way ships are being procured, coupled with the technological advances in computational capabilities are significantly impacting the nature of the ship structural design. This is creating new challenges and demands on the nature of the R&D work, which is required to support these designs. With the current industry-wide trend of pursuing risk-based structural design, new studies on the initiation of failure mechanisms and modes will be required. In addition, advances in the areas of fatigue and fracture mechanics combined with the analytical power of the finite element methods have made detailed and rigorous stress, fatigue and fracture assessment not only accurate and quicker, but also an expectation of the design process.

Structures R&D will continue to be required as there will be a greater need to statistically characterise: material properties (existing and emerging), fatigue and strength properties and the environmental loads imposed globally and locally on the ship's hull. Advances in computational capabilities have made complex structural modelling and analyses a more routine part of the ship structural design process. Alternative arrangements, concepts and materials can be rapidly assessed in the design spiral.

Third, environmental risk. Improved life cycle management and improved attention to the structural integrity of ships is required to assure safety of life at sea and reduced environmental risk. Degradation of ship structures will progress at varying rates depending on numerous design, construction, and operational factors. Corrosion of marine structures incurs considerable costs for preventive measures, as well as, for repair. Time-variable stresses from winds, waves, and service loading lead to damage accumulation and fatigue crack growth. Over the past several years, the SSC has completed several research projects supporting inspection and repair of vessels. New methods of collecting inspection data are needed, and new ideas for integrating these systems being developed, more uniform methodologies for damage assessment and repair documentation are needed both for structural components and for coatings.

Finally, productivity improvement and quality work have long been recognised as some of the key factors in reducing costs and meeting market needs. Advances in computer-integrated manufacturing allow for developing build strategies in parallel with early design activities. Designs can now be assessed for suitability and better tailored to

production facilities. These strategies will result in the reduction of re-works and hence, the initial acquisition cost.

The SSC provides participating agencies with a forum and access to a network of stakeholders and researchers from the North American continent and elsewhere, sharing in the objectives of safer and more efficient ship structures, leading to global application through governmental agencies and the private sector.

Contact: Daniel J. Gauvin, (613) 998-1666 *Project Number: FRBQ6*

Frame Relay Trial

CCG maintains an operational network called CCGNET. This network is using dedicated leased digital circuits from the Megastream services through different Telco providers in Canada. Marine Communication and Traffic Service (MCTS) centres operate a network of remote radio sites through the existing Megastream digital service. Each radio site has a point to point connection to the master centres. Ten years ago, this was the most convenient solution for interconnecting our remote radio sites to the MCTS centres. However, the lack of flexibility in the network and the fact that a point to point connection must be established individually for each leg is a serious impediment to the network management. In the industry overall, the leased line approach is being phased out and replaced with bandwidth sharing and private circuit channel. Nowadays, new telecommunication services like Frame Relay can provide improved flexibility and scalability at a much lower cost of ownership.

This project will test Frame Relay telecommunication technology within a simulated and real operational CG environment. By developing benchmark measures with the existing network and comparing them with the proposed Frame Relay network, this project seeks to demonstrate that the quality of the audio communication should be the same or better than the existing one and that the users should notice no degradation.

The first step began in 2002/03 that set-up a bench test in a lab to simulate 3 remote radio sites and one MCTS centre. For three months parameter measurements data was gathered specifically related to audio voice quality. A test report is being prepared.

The second step follows in 2003/04 which will redo the same tests in a real operational environment. The Frame Relay circuits will be deployed on three real radio sites and on a MCTS centre to validate with the users if the conclusions obtained in the first step are defendable.

This new telecommunication technology could significantly reduce CCG's operational costs. The technology would also provide MCTS centres with more flexibility to its telecommunication infrastructure. Instead of having a very rigid network in a point to point configuration, Frame Relay would provide a way of connecting the radio sites to more than one centre thus mitigating the risk associated with the possibility of loosing one complete MCTS centre.

Contact: Gilles Parent, (613) 993-2710 *Project Number: FQAX6*

Evaluation of Large Electric Double-layer Capacitors for Powering Aids to Navigation

Large electric double-layer capacitor technology is new. Information about this new technology was first released at the 2nd World Photovoltaic Conference in Vienna, Austria in July 1998. NTT has deployed the equipment to boost the photovoltaic power supply system for telecommunication equipment. The performance of the equipment is encouraging. CCG would like to probe the possibility of using large electric double-layer capacitors for powering minor aids to navigation and reduce its overall reliance on batteries.

In the first year of the project, CCG developed requirements for capacitors and associated electronic equipment and tested the equipment with the smaller solar systems and in a stand-alone system (i.e. without batteries). Test trials continue at several locations throughout Canada. Performance results to date are encouraging. A final report of the results is expected in January 2004.

Savings can vary between $2M and $20M over a 40 year horizon, depending on the speed at which the cost of capacitors decrease with increased applications. CCG also expects a reduced number of maintenance trips by ships and helicopters and in the number of batteries to be used.

Contact: Sunny Leung, (613) 998-1390 *Project Number: FQAM6*

Visual and Radar Ranges for Steel and Plastic Buoys

Old steel buoys are being replaced by lighter plastic buoys which are easier to handle and will generate efficiencies in maintenance and operational costs. The client users and CCG officers know the visual and radar range for many of the older steel buoys from years of observation. Unfortunately, no data exists for the plastic buoys. For the CCG Levels of Service (LOS) Officers to accurately design a buoyage system, they need to know the visual and radar range of all the buoys currently available in the CCG. The availability of this information to the LOS Officers can ensure consistency in system design across the country.

This project proposes to develop a computer program, which will calculate the visual and radar range of all the steel and plastic buoys presently used in the CCG. This program will offer the option of allowing the user to input all the necessary parameters of a new buoy and adding it to the database thereby keeping the CCG current in it's information. Field tests are also planned to verify the results from the program.

Financial benefits are anticipated because this may eliminate the use of oversized buoys at some navigational aids sites. Also with properly and consistently designed aids to navigation, reduces the possibility of groundings and/or oils spills and stress for the mariner.

Contact: John Barron, (613) 998-1537 *Project Number: A62AA*

Evaluation of Arctic Diesel Fuel and Marine Diesel Oil Blends with and without Lubricity Additives in Coated Injector Plungers for a Vasa 32 Diesel Test Engine

The wide range of quality in marine fuels represents a real limit on the ability of ship operators, such as the Coast Guard, to maximize the use of their vessels. Proper fuel quality, which includes lubricity factors, is essential to the long life and health of the fuel injection pump plungers and other components in marine diesel engines. Wear rates are critical to effective engine management and, even, safety.

In many locations, the fuel quality is either unknown or suspect in terms of its ability to meet marine engine requirements. For example, diesel fuels transported into Canada's north are refined to have low pour and cloud point temperatures. The additional refining that has to be carried out to lower the pour/cloud point temperatures leads to a fuel that typically will have a lower viscosity. This additional refining also removes polar compounds from the fuel thus reducing the sulphur content and its lubricating qualities. As a result, additives are used to compensate. But even so, there can be questions as to the whether the fuels will fall within the engine specifications for all applications.

If marine operators could more easily determine the lubricity properties of available diesel fuels, and the wear rates, they could adopt alternative fuel conditioning and fuel management strategies. Likewise, if fuel lubricity levels can be established, off-spec fuels might be tolerated for short time periods or additives could be introduced, by the operator, to bring wear rates within desired ranges. For the Coast Guard, this could imply substantial savings in annual fuel expenditures and ship maintenance.

The lubricity project, which is contracted to Advanced Engine Technology Ltd. (AET), served to develop a test apparatus and associated test method to test fuel for its lubricity levels. This is the "Ball on Three Disks" (BOTD) system. In addition to determining diesel fuel lubricity quality, the project team has also developed the capability to assess the adequacy of various lubricity additives to bring the diesel fuel up to acceptable standards, as would be required for CCG engine types. The improved instrumentation and test method can determine the lubricity level of diesel fuels with and without lubricity additives.

The new Ball on Three Disk (BOTD) lubricity test equipment is manufactured by Falex Corporation and the test protocol will shortly be presented to the American Society of Testing and Materials (ASTM). This test method will be validated in an upcoming round-robin test program, which is presently being organized to fulfil requirements of this standards-making organization. ASTM standards are often adopted by other standards making organizations such as the International Standards Organization (ISO). This usually leads to international acceptance of the standard as an ASTM/ISO numbered test method.

To date, laboratory work has also been validated in a series of full-scale diesel engine tests, using a VASA 32 engine belonging to the Nunavut Power Corporation in Iqaluit, Nunavut. These tests have been identified as critical to the acceptance of wear measurements derived from the test apparatus.

As part of this final stage of the project, the team will again test the lubricity additive(s) in this stationary generator set, this time using ceramic coated parts and some new

additive packages. As well, the High Frequency Reciprocating (HFRR) test rig has been added for comparative purposes. This step of testing in a full size medium speed diesel engine is proposed so that any potential longer term engine problem during testing would not jeopardize a CCG heavy icebreaker during a major mission. This final phase will continue to (early) 2005-06.

Subsequent to this test, the industry members of the project will conduct a round-robin test of the additives to validate the results. The results of the round robin will serve as the basis for a submission to the American Standard Testing and Materials (ASTM) organization, mentioned above, to create a new fuel test procedure and fuel standard.

This project will benefit all of CCG's diesel engine application areas through reduced maintenance costs and improved lubricity additive formulation. This project also demonstrates CCG responsible behaviour in the North to help protect an environmentally sensitive area. The project will provide a world-wide standard and associated test equipment.

Although not part of the current proposal, the work on lubricity clearly indicates new directions for marine operators in fuel conditioning and fuel management strategies. Additional (future) work will be proposed in these areas, specifically to respond to changing (regulated) fuel qualities and sources of fuel stock (Tar Sands). This work will also serve to meet Kyoto commitments and to improve operational efficiency.

Contact: Al Dacosta, (613) 998-1776 *Project Number: HCAA6*

REGIONS

Project List Summary

PROJECT NUMBER	PROJECT TITLE	2003/04 (approved)
NEWFOUNDLAND		
FKCT6	Research Project for Increased Wearing of Personal Flotation Devices (PFD)	See HQ OBS list. $ 225K will be transferred from HQ OBS.
	Newfoundland – Total	See HQ OBS list
MARITIMES		
FMDG2	Enhanced Sweeping Methods	25
FKCA6	Development of Response Strategies for Orimulsion/Heavy Oils (Year #3)	$ 285K will be transferred from HQ ER.
FMDH2	Viscous Oil Pumping Systems for Orimulsion® and Heavy Oils	75
New	Ocean Buster – Development of Various Integrated Skimming Systems Installation Methods	60
New	OTTERboom – High Speed Sweep Guide Booms	75
New	Long Term Storage Containment System for Oil Pollution Countermeasure Equipment	55
	Maritimes – Total	290
QUÉBEC		
GMJH3	Wireless Communication Protocol Application for Georeferenced Marine Data Internet Access	70
FJMP3	Dispersion of Oil Spills Stranded in Ice and Its Environmental Fate	65
GMJF3	Squat Study for the Purpose of Re-Evaluating Underkeel Clearance Specifications	292.3
FMCC3	Erosion-Sedimentation Model of the St. Lawrence River	150
GPJN3	Revision of non-commercial Buoy Types	20
FJNF3	Lighted Spar Buoy	337.5
GMJG3	Computer-Assisted Ice Observation System in Helicopters	35
FQAT3	Large Scale Sewage Treatment Plant – Feasibility Study	200
	Québec – Total	1,169.8

PROJECT NUMBER	PROJECT TITLE	2003/04 (approved)
CENTRAL & ARCTIC		
New	Replacement of Lead Paint as Part of Lead Control Program	59.2
	Central & Arctic – Total	59.2
PACIFIC		
New	Web-Based Display of Commercial Fishery-Openings/Traffic Information System (FOTIS) Utilizing Graphical GIS Technology	35
	Pacific – Total	35

Newfoundland

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 R&D priority in support of their overall effectiveness of service delivery operations for this year relates to boating safety.

Research Project for Increased Wearing of Personal Flotation Devices (PFD)

Newfoundland will carry out this project on behalf of the Office of Boating in Ottawa. The project description can be found under Marine Programs, Safety and Environmental Response section.

Maritimes

With regional headquarters located in Dartmouth, Nova Scotia, 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. This year the priority technological opportunities in support of their overall effectiveness of service delivery operations relate to oil spill response and preparedness.

Enhanced Sweeping Methods

The Canadian Coast Guard operates a number of offshore sweep systems from a variety of vessels, both CCG and vessels of opportunity. These systems must be operated at one knot or less to ensure optimum oil collection without entrainment. Most vessels have difficulty maintaining this low speed for extended periods of time that is required during an offshore cleanup operation. A Norwegian boom manufacturer has developed a system that has the potential to achieve sweeping speeds as high as four knots. This system requires testing to assess its operational capabilities / limitations and its feasibility of use in Canadian waters.

One system was previously tested in Victoria, called the "Current Buster". This is a smaller model and is designed for the near-shore.

The Canadian Coast Guard has partnered with SERVS of Aleyska Pipeline, NOFI and NOFO of Norway for the development of a larger version, called "Ocean Buster". Field testing of the Ocean Buster took place in Stavanger Norway in August 2002. Like the Current Buster, the Ocean Buster performed very well. The larger "Ocean Buster" high speed sweep equipment is primarily for the off-shore.

The final field test of the Ocean Buster is to evaluate its performance in a planned crude oil spill in Norway. This exercise and test will be conducted by NOFO of Norway. The crude oil test was to have taken place in June 2002, but due to delays in production, small window of ship availability, and required environmental approvals, the test and evaluation has been delayed until June 2003.

If this technology proves successful, CCG would greatly enhance its response capability. CCG could effectively conduct on-water recovery at a rate of up to 10 fold it's current ability, and collect more oil from the water surface thereby significantly reducing the costly shore-line response. Furthermore, ships will be able to maintain maneuverability without causing extensive and costly damage to vessel gear boxes, and resulting in a premature removal of the vessel from the response activities.

Contact: Ron MacKay, (902) 368-0204 *Project Number: FMDG2*

Development of Response Strategies for Orimulsion/Heavy Oils (Year 3)

Maritimes will manage this project on behalf of the Emergency Response branch in Ottawa. The project description can be found under Marine Programs, Emergency Response section.

Viscous Oil Pumping Systems for Orimulsion® and Heavy Oils

Further to the project on the development of response strategies for orimulsion/heavy oils, the Canadian and United States Coast Guards have entered into a joint research project agreement to test and evaluate viscous oil pumping systems (VPOS) for recovered bitumen and heavy fuel oils.

This Joint Research Project Agreement is directed specifically towards the development, test and evaluation of viscous oil pumping systems currently held in Canadian Coast Guard and United States Coast Guard inventories for the recovery and pumping of extremely viscous oil products resulting from spills of Orimulsion® and heavy fuel oils.

The tests will investigate various attributes and characteristics of pumps within the Canadian and United States Coast Guards with the new steam/hot water injection flanges and water lubrication technologies. Four manufacturers of pumps for extremely viscous oil have accepted to test and evaluate one of their pumps and injection flanges for comparasome and data exchange.

The Canadian Coast Guard tests will focus on extreemly viscous fuel oils and recovered bitumen resulting form spills of Orimulsion®. The objective is to pump this extremely viscous bitumen a distance of five hundred feet with an operational flow rate of 10 cu. meters/hr for the Gt-185 and 20 cu. meters/hr. for the GT-260.

The United States Coast Guard tests will focus on very viscous heavy fuel oils using the Viscous Oil Pumping System (VOPS) that utilizes a DOP –160 and 250 pumps. The objective is to pump this heavy fuel oil one thousand five hundred feet with an operational flow rate of 60 cu. meters/hr

With regulatory responsibilities in the area of spilled oil recovery, the results of this research will provide much needed information to promote the advancement of the technology for improving the efficiency and effectiveness of response operations and costs in responding too incidents involving heavy oils.

Contact: Ron MacKay, (902) 368-0204 *Project Number: FMDH2*

Ocean Buster – Development of Various Integrated Skimming Systems Installation Methods

As a result of CCG partnering in developing new high speed oil sweep technologies as in the case of the Current Buster and Ocean Buster, there is a need to develop integrated skimming systems installation methods for skimmers of various types.

The objective of the project is to make oil spill contingency both technically and economically more efficient, both at sea and along the coastal areas. The Ocean Buster is today the fastest oil collection system on the market. When the separator is full, the oil needs to be evacuated. It will be necessary to either stop the collection of oil and pump out the oil, or use additional costly equipment to evacuate the oil during operation.

By introducing an integrated skimmer, the efficiency will increase dramatically, and reduce the need for investing in additional equipment such as skimmers and/ or skimmer vessels. Additionally, less shipboard deck space and subsequent equipment, ropes, hoses, etc would be required. This would make a more safe work environment for the workers during deployment, operation, and recovery of the system

The purpose of this project is to develop, design and build a complete pump/skimmer system to complement high speed sweep technology such as the NOFI Ocean Buster (OB). The objective is to develop the OB concept from an oil collection system to a fully integrated oil recover system. The system shall mainly comprise the OB with a skimmer unit adapted to the separator part, hose system for supply of hydraulic power to the skimmer unit, hose system for transfer of recovered oil from the separator to the vessels tank system, a control unit and a hydraulically operated boom reel suitable for the OB and the hose system. The equipment shall be easy to handle during deployment and recovery. Technical risk factors, safety and the working environment on deck shall be analysed and benchmarked towards the use of traditional systems in use today.

Evaluation on how the equipment can be prepared for later installation of auxiliary systems such as water injection system, emulsion breaker system and instrumentation packages such as oil thickness measuring unit and camera surveillance unit also be conducted.

By developing a system that will accept various types of skimming devices currently held in inventories, will ensure a continuous and more cost-efficient response by not having to stop the operation to remove the collected product from the containment area of the Ocean Buster. Such continuous operations would significantly reduce the on shore impact of an oil spill and thus reduce future remediation of the shoreline environment.

Contact: Ron MacKay, (902) 368-0204 *Project Number: New*

OTTERboom – High Speed Sweep Guide Booms

As a result of CCG partnering in developing new high speed oil sweep technologies as in the case of the Current Buster and Ocean Buster, there is a need to develop guide booms to match this technology.

The purpose of this project is to examine the possibilities and limitation in using sloping or different skirt depths in oilbooms in order to optimise oilboom configurations. The objective is to develop, produce, test and verify different scaled booms for different applications typically for:

- low speed guidebooms (in front of sweeps, apex booms or inline skimmers etc.);
- high speed guidebooms (in front of Ocean or Current Buster etc.);
- low speed deflection booms (open ocean use in front of normal U or J booms); and
- high speed deflection booms (use in rivers etc.).

If technically possible, also develop a continuous OTTERboom with an incorporated apex part optimised for oil concentration and towing speed. Compared with a normal boom the speed should be increased with around 30-50%. Combining the increased area coverage, the increased speed, and the more concentrated oil for the skimmer, and still using a "normal" relatively inexpensive continuous boom design, the improvement potential are considerable. For core elements of the technology produce a full scale system for field verification by the CCG.

Success in obtaining such guidebooms or subsequent high speed/current performing booms would significantly increase the area covered and encounter rate of on water sweeping responses. Also, development of the subsequent high current boom, would reduce the need of multiple deployments of boom resources and allow placement of these resources at other areas for protection and deflection applications. These two applications would significantly reduce both the asset requirements and response costs associated with an incident cleanup.

Contact: Ron MacKay, (902) 368-0204 *Project Number: New*

Long Term Storage Containment System for Oil Pollution Countermeasure Equipment

Ever increasing fiscal pressures on government make it necessary for finding more efficient and economical methods of conducting business. One such method is to reduce the requirement for heated storage space for specialized pollution countermeasure equipment that will not promote the growth of mould, while maintaining sufficient levels to meet our mandated responsibilities

Traditional storage methods of pollution countermeasure equipment have promoted the growth of mould. This mould has been proven to be a health hazard to workers and in

many cases rendered the equipment unusable in times of need. Such as the case with recovery boom presently placed in response trailers or storage containers in remote locations will result in similar mold growth.

There is a priority need to design, development, and monitoring of air quality of a storage/container system for response equipment (i.e. inshore boom). The system is required to prevent the growth of mould associated with this type of long term unheated storage. Self-contained storage units to meet these required specifications are not commercially available. Therefore, the design and development of such a storage system is warranted.

This project proposes to design and build a prototype container for equipment that does not require heated storage space, i.e. 18" - 36" boom and associated sundry accessories. Container specifications are: container is not to exceed 20 ft in length, preferably have doors that open at either end, and a method to hang boom for maximum air circulation rather than the traditional method of stacking the boom. The system should provide a low maintenance and cost effective means of air circulation, such as a solar powered ventilation system.

Three such containers will be constructed and filled with boom and accessories (from existing inventory) and placed in the field for one year (four seasons) in areas of varying climatic conditions. One container for the colder dryer conditions, the second for the salt air, humid, and heat and cold conditions, and the third for the hot summer and damp winter conditions. Inspection and air quality control readings will be taken during the test period. Successful conditions are expected and the knowledge learned can be used to retrofit existing boom trailers.

A system of this type will provide an economical means of storing equipment in a manner that will maintain its operational requirements and ease of deployment as well as maintaining a safe and healthy work environment for employees or users.

Contact: Ron MacKay, (902) 368-0204 *Project Number: New*

Québec

With regional headquarters located in Quebec City, Québec, 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: ice information management, marine traffic management, aids to navigation, erosion/sedimentation mechanisms, SAR and environmental response.

Wireless Communication Protocol Application for Georeferenced Marine Data Internet Access

The first phase on the use of a wireless communication protocol for accessing georeferenced marine data concluded that the shipborne Automatic Identification

System (AIS) is the best option for transmitting such data aboard vessels. In the near future new regulations will be introduced that will require all ships to be outfitted with an AIS transponder.

The CCG has developed the CARIS Spatial Fusion platform, which accesses georeferenced data from various sources in order to broadcast them in graphic format. This technology allows waterway user-clients to have Internet access to certain critical information (bathymetry, shoal advisories, and notices to shipping), increasing their level of safety and fostering competitiveness in maritime commerce. However, there is no technology at the moment that can transmit real time data to aboard ship. It is hoped that AIS will address this problem.

Phase II will conduct a feasibility study with a view to using AIS as a communication medium for transmitting georeferenced data critical to navigators directly to the vessel bridge; and if the study is conclusive, proceed with developing and conducting a field trial of a transmission prototype.

The resulting technology will improve CCG's service delivery responsibilities and reduce communication charges for access to data. The technology will provide instantaneous generation and communication of detailed marine information for a variety of users.

Contact: Jean-François Coutu, (418) 648-7019 *Project Number: GMJH3*

Dispersion of Oil Spills Stranded in Ice and its Environmental Fate

Phase I demonstrated that it is possible to encourage the bioflocculation of oil and its dispersion into the environment when fine particles are present in the water.

In ice-infested waters such as the Saguenay and St. Lawrence, there are no known "recipes" for facilitating the natural dispersion of petroleum products by bioflocculation in the presence of mineral fines. The use of an icebreaker or a combination of other types of Canadian Coast Guard (CCG) vessels, in conjunction with an appropriate application of mineral fines, whether available in the natural environment or artificially introduced, is the approach suggested by CCG's Rescue, Safety and Environmental Response (RSER) Division in order to intervene and disperse petroleum products stranded in ice that cannot be recovered by traditional methods.

The present project therefore consists in conducting appropriate studies and research, first of all to fully understand turbulence phenomena in the hydrodynamic field around conventional icebreakers and to assess the extent to which this turbulence can be optimized for the bioflocculation of petroleum products stranded in ice. Secondly, once the phenomena in play are fully understood, the project will develop a simple and effective countermeasure for oil spills.

Delivery of this project will probably result in the development of a simple and inexpensive countermeasure for oil spills in ice-infested waters. Although unknown for the moment, it is expected that the reduction of response costs for CCG will be substantial. The proposed method should permit the hydrocarbons to bioflocculate rapidly, disperse, and biodegrade quickly in the environment, with improved control in time and space.

Contact: Martin Blouin, (418) 648-4557 Project Number: FJMP3

Squat Study for the Purpose of Re-evaluating the Underkeel Clearance Specification for the St. Lawrence River

The loading capacity of ships travelling the St. Lawrence is directly related to three elements: (1) the maintained (dredged) depth of the channel with respect to the chart datum; (2) the elevation of the flat body of water with respect to the chart datum; and (3) the various dynamic factors and phenomena which are included in the underkeel clearance calculation (squat, roll and pitch, etc.). Squat, which is defined as the measurement of the sinking (or the equivalent) of the ship when in movement, is one of the components in the underkeel clearance (UKC). This squatting, which varies mainly due to the speed and width of the ship, the static draft and water depth, is evaluated based on a theoretical formula which has never been validated under actual conditions of use and the accuracy of which can vary from one ship to another. This formula constitutes the basis of the UKC standard which has been in force since 1992 on the navigable channel of the St. Lawrence between Montreal and Quebec City. The UKC standard, which was implemented for reasons of safety and environmental protection, is managed and enforced by the Maritime Communications and Traffic Services (MCTS) of the Canadian Coast Guard (CCG).

Climatic changes predicted for the short- and medium-term suggest that the water level of the river could dip more frequently beneath the average than it has in the past 40 years. At a time when dredging is the subject of many environmental concerns, a better knowledge of the ship squat phenomenon, with a view to optimizing the column of water available for navigation, could be an interesting alternative to dredging should the maintained depth of the navigable channel need to be increased to ensure competitiveness of ports along the St. Lawrence.

An earlier study has concluded that the squat evaluation obtained by the formula currently in use could be too conservative for some types of ships, particularly those with high drafts. The recent development of GPS "On the Fly" (OTF) technology has shown the potential to measure squat phenomenon accurately and will be used in this study to validate the current theoretical equation under actual operational conditions.

This study proposes to re-evaluate the underkeel clearance standard in force on the St. Lawrence in three phases. Phase 1 (2001-2002) consisted of a feasibility study. The study concluded that the approach based on use of GPS-OTF technology makes it possible to measure squat with interesting accuracy. Phase 2 (2002-2003) will be the planning and collection of data based on the findings in Phase 1. Phase 3 (2003-2004) will be devoted to conducting the measurement exercise, processing the data and determining the squat of ships based on the various parameters that influence these phenomena. The results obtained will be analysed in light of the current underkeel clearance (UKC) specifications. If necessary, requirements for additional measures will be defined so as to revise the UKC specifications currently in force.

Optimizing UKC offers several benefits. It will help CCG ensure safe shipping, preserve the coastal regions and oceans and produce potential fuel savings for the marine industry. The findings of the study could also lead the CCG to revise downward the squat factor in the application of the UKC standard, the marine industry could increase

load capacity of its ships without further deepening the navigation channel. This would help maintain or improve the competitiveness of Canadian ports along the St. Lawrence.

Contact: Pierre Rouleau, Eng., (418) 648-7493 *Project Number: GMJF3*

Erosion/Sedimentation Model of the St. Lawrence River

The potential impact of maritime navigation and the maintenance of the St. Lawrence Waterway have been the subject of numerous comments and concerns, following Environment Canada's publication of a background paper on the condition of the St. Lawrence in 1996, and the submission of an impact study during the course of a project to deepen the waterway. These events lead to the creation of a navigation co-operation committee which brings together representatives of government, the maritime industry and the community who have a mandate to find means of limiting the impact of navigation on the environment. The main concerns raised by the committee are bank erosion, the destruction of fauna habitats and dredging-related impacts. In conjunction with the committee's work, the purpose of this project is to develop a software which is capable of modeling the influence of navigation and maintenance of the waterway on bank erosion of the St. Lawrence between Cornwall and Cap Gribane at the end of the North Traverse. The knowledge gained from these projects will enable various departments to be better informed to respond to concerns expressed by interest groups and the general public.

In addition, the numerical model will be used in the International Joint Commission (IJC) study to review the criteria for Lake Ontario-St. Lawrence River water-level regulation. It will be used to simulate erosional processes in the fluvial portion of the St. Lawrence.

This project is undertaken in partnership with National Research Council's Canadian Hydraulics Centre (CHC), Environment Canada and the Science Directorate of Fisheries and Oceans Canada. Their expertise combined will develop a software which includes a mathematical sedimentation-transportation model and a graphic interface. The model will provide CCG with a tool for the analysis and understanding of the phenomena of erosion, sedimentation and lapping (ship-generated waves) in the St. Lawrence.

The numerical model will be of benefit to the CCG in that CCG will be better informed to manage dredged sediments, assess environmental impacts of navigation and maintenance of the waterway and respond to concerns raised by interest groups and the general public regarding certain CCG activities or development projects.

Contact: Pierre Rouleau, Eng., (418) 648-7493 *Project Number: FMCC3*

Revision of Non-commercial Buoy Types

Until about ten years ago, floating buoy systems in the pleasure craft channels of Canada utilized steel buoys. The steel navigation buoys have been gradually replaced by a number of plastic buoys of various types and shapes. These synthetic buoys were often either the same shape or size as the former steel buoys.

Based on recent reviews of the level of service in pleasure craft channels, we believe that we could improve client services and possibly reduce program costs by introducing new sizes and/or models of buoys that are made of synthetic materials and better suited to their intended purpose. Also, these same reviews indicated that the performance of the steel buoys remaining in the system could also be improved through the development of equipment that would improve their basic performance.

The aim of this project is to reduce costs for the installation, removal, maintenance and life cycle management of non-commercial buoys. The work will address four main problem areas: divergence stability of lamps, stability, handling and maintenance of barge buoys bearing information panels, replacement of SB-101 buoys with buoys having a higher visual range, and a buoy that could remain in place year-round in areas where conditions permit. The project will establish target levels of service, performance criteria, and test two prototype "divergence stabilizers" for lamps. The data collected from these activities will be used to develop procedures for buoy selection and product evaluation based on pleasure craft channel conditions.

The application of new technology and features would ensure maximum effectiveness and efficiency of aids to navigation equipment and the level of service to recreational clients. CCG will save in operational costs through reduced transits to sites for the installation/removal, maintenance and repair of buoys.

Contact: Sylvie Pelletier, (418) 648-7450 *Project Number: GPN3*

Lighted Spar Buoy

Every year, the Quebec Region faces pressure from the marine industry to leave the lighted buoys in place as long as possible in the fall and to put them back as soon as possible in the spring. Furthermore, the requirement to go to the same place twice a year to change the spar buoy for the lighted one (and the reverse) involves considerable CCG resources.

This project, therefore, is designed to improve the level of service to commercial navigation during the winter period. The development of 2 different spar prototypes will have to be considered.

The first prototype will be developed to withstand medium-density ice conditions and incorporate a lighting system into the buoy. The aim would be to have a single annual visit either to check the spar or completely replace it.

The second prototype will be designed for more severe ice conditions and would not have a permanent lighting system. The challenge will be to design a lighter buoy with a body capable of resisting damage as much as possible and improve the air draught. The aim is to incorporate a seasonal lighting system in the spring and increase its visibility during the day by adding floats or any other form of day mark.

The buoys will be tested and assessed over a period of two years to determine if they meet expected operational needs.

The development of an all-season buoy or lighted spar will offer year-round lighted buoy service and reduce the use of CCG ships to lay, remove and maintain buoys. CCG will

also be able to meet the requirements of the marine industry to have a lighted night-time buoy system in winter with good radar reflection.

Contact: Allan Blanchard, (418) 649-6999 *Project Number: FJNF3*

Computer Assisted Ice Observation System in Helicopters

Work in this area has led to the development of the "ICEggs 3.2" application for use on a pen computer used in conducting daily ice patrols by helicopter or ship. It is being used (from July to September 2002) to test reconnaissance of ice observations for Arctic patrols as well as on the St. Lawrence River from December 2002 to March 2003. Plans are in place to officially implement the version in November 2003 as the operational working tool for ice observers in conducting ice reconnaissance patrols by helicopters on the St. Lawrence River, rather than the conventional method.

The successful ICEggs application for aerial ice observation has caught the interest of environmental response personnel that conduct aerial observations of oil slicks. As a result, the scope of the project has been revised to include the development of an initial application version or prototype to be known as SpillView 1.0. The prototype development will be based on the major concepts and/or functions of the ICEggs.

The project will develop and integrate the interfaces/functions that will permit each application (ICEgg & SpillView) to share information gathered in the field with related and/or complementary systems.

The development of these products will result in improved distribution of information on daily ice patrols and the management of responses to oil spills. The product will offer better communication with the Canadian Ice Service Centre and increase the efficiency of CCG's daily operations.

Contact: Jacques Dostie, (418) 648-5406 *Project Number: GMJG3*

Large Scale Sewage Treatment Plant – Feasibility Study

Over the last several years, awareness of pollution from ships has grown. Ship-sourced discharges fall into several categories. To date, oily wastes, chemicals and solid waste has been regulated to some degree. Sewage has been partially regulated but, of late, concern on this front is rising. Pressure is rising to deal with both waste from commercial (non-passenger) traffic, rising cruise line business, and a burgeoning recreational boating population.

Several international protocols have been established, both under IMO and through domestic legislation, to address the levels of allowable discharges of solid, chemical and oily wastes from large commercial ships, as well as the areas in which wastes can be discharged. In the Arctic, the 1997 Arctic Waters Pollution Prevention Act (and pursuant regulations) effectively created a zero discharge regime for solid, chemical and oily wastes. In more southerly (inland) waters, less rigorous regulations for oily wastes are applied under the Canada Shipping Act and the Great Lakes Pollution Prevention

Regulations. Oil concentrations of up to 5 ppm are tolerated. In other inland waters, the territorial seas, and on the high seas, even less rigorous standards apply.

This project proposes to install a biological waste treatment system on an "R" class CCG icebreaker to test and evaluate the technology for a large scale system. Data collected from the operational tests will be used to show that the system is feasible; i.e. it is practical, effective and compliant with the most rigorous standards.

The new technology would effectively provide a single process to deal with discharge overboard that complies with the existing Arctic regimes and the impending IMO regime for sewage discharges.

Contact: Jacques Mondy, (418) 648-3208 *Project Number: FQAT3*

Central and Arctic

With regional headquarters located in Sarnia, Ontario, this region selects R&D projects to assist in their challenges to adapt to trends in operational demands and 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: SAR and environmental response, icebreaking and support to environmental standards for the protection of the fragile Arctic environment.

Replacement of Lead Paint as Part of Lead Control Program

In the 1980's high performance coatings were introduced which replaced lower durability paints that are applied to the Aids to Navigation buoy equipment. Currently used paints have shown unacceptable lead levels while under-going indoor air quality and occupational hygiene monitoring in the paint and welding shops. Recent studies done by Golder Associates have shown that a lead control program was necessary. Field Services has now implemented a lead control program based on a study by Pinchin Environment that was completed in July 2001. This program requires regular cleaning with HEPA filtered equipment, PPE and then removal of the hazardous waste following cleanup.

The objective of this project is to find a replacement for lead based paints while maintaining the same life and durability of currently used paints. This project will review and evaluate the availability of safe, lead free paints for use at the Prescott base and make a recommendation on the safest, cost efficient paint.

The benefits of this project are directed at the health and safety of employees during normal maintenance operations. It is an occupational "due diligence" study. In addition, the cost of removing hazardous waste will be reduced.

Contact: Doug Hayes, (613) 925-2865 *Project Number: New*

Pacific

With regional headquarters located in Vancouver, B.C., this region selects R&D projects to assist in adapting to local trends in operational demands, strategic changes in levels of service and evolving expectations from clients. This year the priority technological opportunities in support of their overall effectiveness of service delivery operations relate to marine communications and traffic services.

Web-Based Display of Commercial Fishery-Openings/Traffic Information System (FOTIS) Utilizing Graphical GIS Technology

The busiest time of the year for MCTS is during the summer months (May – October) when there is an increased number of pleasure craft, cruise ships, tugs-and-tow, and other commercial vessels. This coincides with a higher volume of marine incidents (people in the water, fires, sinkings, medevacs, overdues, groundings, pollutions, etc.) and other activities in MCTS' areas of responsibility (AORs). It is also the main commercial salmon-fishing season.

The current procedures utilized by MCTS-Pacific Region for receiving, processing, and disseminating commercial fishing information to marine traffic in our AOR are cumbersome, outdated, and very time consuming.

The development of FOTIS will lead to an easy-to-use, publicly accessible website that provides accurate and concise commercial fishery-openings information in a *visual* geographic format. Coloured polygons representing the open fishing areas will be overlaid on existing electronic charts of the statistical fishing areas and sub-areas, along with dates, times, and gear types. Anyone with Internet access will be able to access the current and future commercial fishery openings very quickly, without having to read through exhaustive pages of text.

This project will identify information requirements and create the most appropriate internet-based software platform for FOTIS. Information will be gathered through consultation with potential system users; MCTS traffic clients, fishery managers and biologists, commercial fishers, recreational boaters, members of the public, and Fisheries and Oceans GIS professionals already on staff at Regional Headquarters.

FOTIS will provide MCTS officers, along with a multitude of other marine users, with accurate and up-to-date information on commercial fishing information and marine traffic. The major benefit of the system will be increased safety for all people and vessels transiting the waterways, thereby giving a higher degree of environmental protection. A secondary benefit is time saved by MCTS officers in their ability to disseminate the information automatically.

Contact: Wendell Hoyseth, (250) 627-3074 *Project Number: New*

NEW SEARCH AND RESCUE INITIATIVES FUND (NIF)

The New Search and Rescue Initiatives Fund (NIF) is a unique undertaking by federal and participating provincial, municipal and private Search and Rescue (SAR) organizations. It's objective is the saving of lives by enhancing SAR prevention and the provision of SAR services. NIF is not specifically oriented to R&D projects but, rather, was established by the federal government to provide funding to new initiatives which enhance the effectiveness of SAR by all participants, especially those outside government.

NIF is managed by the National Search and Rescue Secretariat (NSS) reporting to the Lead Minister for Search and Rescue (the Minister of National Defence).

Within CCG, it is managed as a separate program within the Safety and Environmental Response Directorate (SERS). For the CCG R&D Program, NIF funded research projects are reported when a research project is sponsored by CCG.

For 2003/04, the data collection from Bedford Institute of Oceanography (BIO) to support research into CANSARP validation continues and several new projects will start. Below lists the projects NIF will fund within the budget level and those within the over-programmed budget.

To obtain more information about these projects, please contact Joanne Clouâtre at (613) 990-3120, CCG SAR Specialist.

Project List Summary

PROJECT NUMBER	PROJECT TITLE	2003/04 Approved
2002038	Ingestion of Grand Bank Surface Current Data into CANSARP	38.6
2003027	SAR Access to Vessel Monitoring Information	151.8
2003028	Self-Locating Data Marker Buoy (SLDMB) Project Phase II – Deployment Strategy	117.7
2003023	Personal Emergency Locator Device	200.7
2003022	Location-Based Risk Analysis of Recreational Boating Activity	232.1
		Over-programmed
2003026	Cruise Ship Activity and Risk Analysis for Improved SAR Response Planning	138.6
2003032	Coherent UHF Radar for Small Target (Liferaft) Detection: Phase 2	83.7
	NIF – Total Approved Total Over-programmed	**740.9** 222.3

Ingestion of Grand Bank Surface Current Data into CANSARP

Surface currents for the Grand Banks can be predicted from advanced computer models developed at BIO/DFO. The models have been implemented on the BIO Ice-Ocean Forecasting System. The system generates 48-hour forecast of surface currents and other ocean variables for the Grand Banks everyday. This real time and near real time data is the most critical type of information required for CANSARP and the SAR system.

The project proposes to develop an interface for transferring the data to the CANSARP environment and modify several modules of CANSARP 4. It is this data that will assist CCG's project officer, Jean Maillette, in his work to validate CANSARP 4. The description for his work is found in the Safety and environmental response – search and rescue section.

Together, BIO and CCG are working to bring new data to CANSARP in order to improve their ability to predict search areas for the Grand Banks and north east coast of Newfoundland.

Contact: Charles Tang, DFO Maritimes, (902) 426-2960 Project Number: 2002038