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The Canadian Coast Guard Research and Development Plan lists those research projects planned for fiscal year 2004-2005 by the various branches and regions.

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FY 2004-2005
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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.

The Coast Guard R&D Program has been traditionally funded at \$3.5 million dollars. Due to serious financial pressures in the CCG, the 2004-05 budget has been reduced to \$1.285M for the R&D Program. No new projects were allowed to start. Only ongoing commitments were honoured. The R&D Program Office continues to make a case that, even at a time of constrained funding, a vigorous basic R&D program is indispensable to preserve the effectiveness of CCG services in the years ahead. Additional support from industry and international partners is being pursued.

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. Benefit cost ratios of 10:1 are consistently achieved. The value of this research is undisputed.

On December 12, 2003, Prime Minister Paul Martin announced that the CCG will become a special operating agency (SOA) within Fisheries and Oceans. The change is made in recognition of CCG's importance to Canadians and its unique nature and operating environment. CG's strategic directions will continue to emphasize organizational evolution from a broad-based service delivery group to a more finely-tuned organization.

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. The R&D program assists in meeting new management strategies relating to changes in levels of service and client advice on the marine program. Finally, the CCG research activity also complements the departmental ocean strategies by supporting a shared knowledge base in theme areas of mutual or overlapping interest.

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 maritime security and the marine electronic highway are 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. 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 standards, training and certification procedures for CCG vessels;
- 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.
- modernization of aids to navigation by developing lighter and lower maintenance buoys.

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.

This Research and Development plan reflects those activities undertaken within the CCG, in direct support of CCG's business lines: Navigation Services, Safety and Environmental Response Systems, and Fleet Management. Services from the Integrated Technical Services branch are used for the delivery of "technical" solutions within CCG.

The R&D program is coordinated at Headquarters (HQ) Ottawa and delivered at HQ branches or in the regions. A brief overview of the groups involved in the delivery of the R&D program follows.

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. Also part of Navigation Services is Icebreaking operations which include 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. The R&D activities focus on investigating and evaluating promising new technologies that can modernize and improve service delivery without compromising marine safety or service to the public.

Safety and Environmental Response Systems conducts R&D in the following major program areas: marine search and rescue, environmental response, and marine communication and traffic services. The R&D activities provide knowledge, technologies and tools to improve efficiencies and reduce expenditures.

Fleet Management provides leadership in the development, implementation and execution of a national Fleet management framework, to remain effective and operationally ready to deliver core marine services to Canadians and support to departmental programs. Within available resources, Fleet additionally provides additional sea and air support to other government departments (OGD).

Integrated Technical Support provides project planning and management services for the delivery of technical solutions and/or service delivery needs identified by Marine program R&D managers.

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 co-ordination of the program.

Risk Management is responsible for the development of a marine services Risk Management Program. Its R&D focus pertains to the development of a comprehensive marine activity and risk model to address CG planning issues as well as to serve as an important component of coastal mapping.

**FY 2004-2005
Approved Budget Summary**

Project No.	Project Title	04/05 Approved Budget	
		CCG R&D	Partner
FKCA6	Development of Response Strategies for Orimulsion	285	120
FTPA6	Cross-Polarized Radar Trials	50	30
FQBK6	Hearing Standards for Seagoing Personnel	60	
FQAG6	Vision Standards for Seagoing Personnel	175	
HCAA6	Evaluation of Arctic Diesel Fuel and Marine Diesel Oil Blends with and without Lubricity	100	
FMDK2	OTTERboom High Speed Sweep Guide Booms	70	
FJMP3	Dispersion of Oil Spills in Ice & Its Environmental Fate	100	
GMJF3	Squat Study for the Purpose of Re-evaluating Underkeel Clearance Specifications	60	
FMCC3	Erosion-Sedimentation Model of the St. Lawrence River	114	
FJNF3	Lighted Spar Buoy	211	
FQAT3	Large Scale Sewage Treatment Plant for Cruise Vessels	60	
	Total CCG R&D Funds	1,285	150

Development of Response Strategies for Orimulsion

The objective of this project is to review and test new recovery technologies for Orimulsion™.

Orimulsion™ is currently being shipped to the Dalhousie Generating Station in New Brunswick and can be quite difficult to cleanup once spilled. It 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 and are just beginning to understand its impacts on the marine environment.

Any R&D work conducted on recovering Orimulsion will also benefit responders in dealing with other heavy oils, such as Bunker C. Recent incidences, such as the Erika incident off the coast of France in 1999, demonstrates this point.

This project began in 2001/02 when the International Orimulsion Working Group was formalized. Together they developed a five-year research plan to evaluate new and existing oil spill recovery methods and techniques to assist in the advancement of recovering Orimulsion. The plan consists of five subject areas: shoreline recovery, mechanical recovery, biological studies, chemical/physical studies and detection/tracking.

Now in the fourth year of the five-year plan, work continues to address the 5 subject areas. CCG and its various partners have had significant learnings and understandings of Orimulsion™ and its properties when spilled in the marine environment.

Through joint project agreements, Canadian commercial enterprises have been able to produce and test retrofits to existing equipment in CCG inventories to make them a viable productive piece of equipment without having to make major capital investments.

The benefits to Coast Guard are associated with an increased capability to respond effectively to a spill and thereby reduce environmental impacts.

Some examples of commercially viable products that have become available for the international market are:

Environment Recovery Equipment Inc. Port Colborn Ont.:
Re-Floater: accelerates surfacing of bitumen droplets & is recommended as a response strategy by Bitor America.

Oreliminator: one of the only bitumen/heavy fuel oil skimmers that is effective in recovering very viscous oils

Navenco Marine Inc. Montreal PQ. & FlemingCo Denmark:

Annular Water Injection Flange (AWIF) for both the inlet and discharge for the GT series of positive displacement pumps

GT-185 platewheels and backing plates; this is a must have item when pumping very viscous fuel oils such as recovered bitumen from Orimulsion.

GT-260 platewheel; like the GT-185, this is a must have item when pumping very viscous fuel oils such as recovered bitumen from Orimulsion.

Navenco Marine Inc. Montreal PQ:

DOP 160 platewheel & sealing ring; this is a must have item when pumping very viscous fuel oils such as recovered bitumen from Orimulsion.

DOP 250 platewheel & sealing ring; like the DOP 160, this is a must have item when pumping very viscous fuel oils such as recovered bitumen from Orimulsion.

Contact:	Ron Mackay, Maritimes Region, (902) 368-0204	
CG Branch:	Rescue, Safety and Environmental Response	
Funding:	CCG R&D Program	\$1,042,000
	Environment Canada	\$ 295,000
	Bitor Corp.	\$ 55,000
	N.B. Power	\$ 7,500
	USCG	\$ 75,000
Schedule:	Fiscal Year 2001/02 – Fiscal Year 2005/06	
Project Number:	FKCA6	

Cross-Polarized Radar Trials

One of the problems affecting ships 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. This project will trial a low-cost X-Polarized radar that uses technology that is commercially available but slightly modified.

The X-Polarized radar trials will be completed in three phases:

1. The Cross-Polarized radar prototype has been demonstrated to work properly.
2. The prototype was installed on the MV Arctic last year. This winter trials and data collection are taking place. A CCG officer will make a trip on the vessel to evaluate the system in an operational setting.
3. The final phase (04/05) will be the evaluation summary and data analysis.

Fednav was so impressed with the radar image produced by the Modular Radar Interface (part of the cross-polarized radar system) for ice navigation that they supported a proposal to the Canadian Space Agency through their daughter company Enfotec, to implement a radar image interface to the MRI in their IceNav ice navigation software package. They will further trial their implementation on the MV Arctic using a second MRI purchased for this purpose, and may eventually support X-Pol radar imagery through the same interface.

The Ice Navigation Simulator developed by Transport Canada through a contract to PhiloSoft of St-Laurent, fully supports the type of ice navigation afforded by the radar system currently on trial on the MV Arctic.

Direct benefits to the CCG include:

- The reduction in the cost of CCG icebreaking operations due to an improvement in route planning resulting from better detection of hazardous and difficult ice conditions.
- The reduction in the cost of icebreaking operations due to the reduction in calls for assistance due to ice damage or impeded progress.
- The reduction in the risk of damage to vessels by increasing the detection capability of multi year ice, growlers and bergy bits.
- The reduction in the potential risk of pollution because of increased detection of dangerous ice conditions.
- A general increase in navigational safety owing to better hazardous ice detection.

The availability of the X-Polarized radar technology at an affordable cost to commercial operators will reduce their dependence on Coast Guard Icebreaker Operations, and improve their operational efficiency by avoiding difficult ice conditions. For example, over the past winter, using the cross-polarized radar combined with other available technologies, the MV Arctic was able to save over 24hrs in transit.

The Canadian companies involved in the development of the X-Polarized radar technology will directly benefit from these developments by allowing them to access a market segment, which is currently not occupied.

Contact: Fiona Robertson, Icebreaking (613) 998-1581
CG Branch: Navigation Services
Funding: CCG R&D Program \$290,000
Program of Energy R&D (PERD) \$195,000
Transportation Development Centre \$190,000
Schedule: Fiscal Year 1997/98 – Fiscal Year 2004/05
Project Number: FTPA6

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 by 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 research will also be conducted in French to ensure fair and equitable results in both official languages. One last task nearing completion is the testing of 50 incumbents with different number of years experience, different patterns of hearing status and no history of incidents or accidents to determine whether or not they meet the established norms. This final task will determine the usability of the "Hearing In Noise Test (HINT)" that is being recommended by the research data.

The results of the research work are being prepared in a final report for presentation to CG senior management. Upon Senior management accepting the final report, the Director General, Fleet will submit the report to Health Canada directing Health Canada to amend the existing hearing standard in the occupational Health Assessment Guide, Section 2 – Occupations, 2-11-1 Seagoing Occupations to reflect the recommended standard identified in the research.

The establishment of *BFOR's* will serve the Employer's interests in ensuring individuals with impaired hearing can (or cannot) work under certain conditions associated with their regular work duties.

At the same time it will mean fewer challenges from the Human Rights Commission and substantial savings in litigation costs.

It is expected that as the results are distributed, other employers inside and outside of the Marine environment will build on this research.

Contact:	Sharon Robertson, Headquarters Ottawa (613) 990-2573	
CG Branch	Fleet	
Funding:	CCG R&D Program	\$550,000
	Conservation and Protection	\$200,000
Schedule	Fiscal Year 1999/2000 – Fiscal Year 2004/2005	
Project Number	FQBK6	

Vision Standards for Seagoing Personnel

Similar to the hearing standards project CG has underway, the vision standards project addresses a Bona-Fide Occupation Requirement for vision standards for seagoing personnel that will be defensible against challenges from the Canadian Human Rights Act and the Supreme Court of Canada.

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 project is divided into two phases. Phase 1 – task analysis and initial scenario planning – involved going on ships to observe operations against which minimum vision requirements will be defined. Phase II – simulating the actual testing scenarios – will get underway in 2004/05 and will involve returning on board vessels to conduct actual field research testing using seagoing personnel. This will be followed by data analysis, presentation of findings for review and comment and writing of a final report based on feedback. Acceptance of the final report is anticipated by the end of fiscal year 2004/05.

The establishment of a recognized BFOR vision standard will ensure a safe workplace and at the same time comply with the Canadian Human Rights Act. This is groundbreaking research and CCG is receiving high accolades from other Government Departments, i.e., Transport Canada, Health Canada, Correction Services, Canada Customs & Immigration, etc; as well as the marine industry.

It is expected that as the results are distributed, other employers inside and outside of the Marine environment will follow on the back of this research.

Contact:	Sharon Robertson, Headquarters Ottawa (613) 990-2573	
CG Branch:	Fleet	
Funding:	CCG R&D Program	\$450,000
Schedule:	Fiscal Year 2000/2001 – Fiscal Year 2004/2005	
Project Number:	FQAG6	

Evaluation of Arctic Diesel Fuel & Marine Diesel Oil Blends (with and without Lubricity Additives)

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, Headquarters Ottawa (613) 998-1776
CG Branch:	Integrated Technical Support
Funding:	CCG R&D Program \$1,400,000 Numerous Industry Partners and GNWT \$3,000,000 Numerous Companies \$ in-kind support
Schedule:	Fiscal Year 2002/2003 – Fiscal Year 2005/2006
Project Number:	HCAA6

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 development of these new high speed booms have improved sweep speeds, but there are still some issues to be solved. In the past, our focus has been on the critical apex area where oil is lost. This problem is more or less solved. Less focus has been set on the guideboom where the actual area coverage is created.

The goal of the current project is to improve the area coverage of a “normal” boom with around 20-40% without reducing its performance.

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.

With the feasibility study completed and preliminary boom designs under review, the research team will conduct test tank verification and CCG field test verification of the different type of boom designs for different applications identified above.

This project began primarily through a joint project agreement between CCG, AllMaritim AS and NOFI Tromso AS in Norway. The project is cost shared: CCG portion represents 46% while NOFI’s contribution represents 54% of the total project costs.

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.

Benefits to others such as RO's would be similar to those realized by Coast Guard. There is room for commercialization of the integrated skimming systems to accommodate a variety of pumping mechanisms currently held in inventories to complement the Ocean Buster technology.

If successful, there are many potential markets worldwide.

Contact:	Ron Mackay, Maritimes Region (902) 368-0204	
CG Branch:	Safety and Environmental Response	
Funding:	CCG R&D Program	\$145,000
	NOFI Tromos (Norway)	\$157,000
Schedule:	Fiscal Year 2003/2004 – Fiscal Year 2004/2005	
Project Number :	FMDK2	

Dispersion of Oil Spills in Ice Infested Waters

This project will study and assess the effectiveness of using an oil/mineral fine aggregate as a natural means of dispersing oil stranded in an ice field. The findings of the study should make it possible to define the broad outlines of a strategy for responding to oil spills in ice-infested waters.

This project is being carried out in two phases. The first phase, which ended in March 2002, demonstrated that it is possible to hasten the bioflocculation of oil and its dispersion into the environment when fine particles are present in the water.

The present project will therefore consist in conducting appropriate studies and research, first of all to fully understand the turbulence phenomena in the hydrodynamic field in the presence of an ice cover and to assess the extent to which this turbulence can be optimized for bioflocculation of petroleum products stranded in the ice. Second, once the phenomena involved are well understood, this project will develop a simple and effective procedure for responding to oil spills in such circumstances.

An understanding of the various mechanisms involved and the parameters that govern the fine sediments/oil/ice-infested waters system is essential to developing an appropriate approach for dispersing oil stranded in ice.

This project should result in the development of an effective and inexpensive method for responding to oil spills in ice-infested waters. Although unknown for the moment, the reduction in response costs for CCG is expected to be substantial.

If the project yields the expected results, a simple, ecologically sound method will be available for responding to oil spills in ice-infested waters. Instead of letting the oil drift with the ice and disperse into the environment randomly as the ice melts, the proposed method should permit hydrocarbons to bioflocculate rapidly, disperse and biodegrade quickly in the environment, with improved control in time and space.

This project could have a strong impact on Canada's participation in the "International Arctic Council" which is made up of some ten countries in contact with the Arctic Zone. Within that Council, there is a working group (the "Emergency Prevention Preparedness and Response", EPPR), which includes Canada. The chief mandate of the group is to seek to improve intervention methods in cases of spills in the Arctic. This project could therefore give Canada an important role in the fulfilment of that mandate.

Dissemination of the results at international symposiums could be a means of extending the above benefits to industry worldwide.

Contact: Martin Blouin, Québec Region (418) 648-4557
CG Branch: Safety and Environmental Response

Funding: CCG R&D Program \$270,000
Schedule : Fiscal Year 2002/2003 – Fiscal Year 2004/2005
Project Number: FJMP3

Squat Study for the Purpose of Re-Evaluating Underkeel Clearance Specifications

The loading capacity and safety of ships travelling the St. Lawrence are directly related to three factors: (1) the maintained (dredged) depth of the channel with respect to the chart datum; (2) the water level with respect to the chart datum; and (3) the various dynamic factors and phenomena that are included in the underkeel clearance calculation (squat, roll, pitch, etc). Squat, which is defined as the measurement of the sinking of the ship when in movement, is one of the components of underkeel clearance (UKC). This squat, which varies mainly according to the speed, width, and static draft of the ship and the depth of the water, is estimated by means of a theoretical formula that has never been validated under real operational conditions and whose accuracy can vary from one ship to another. This formula constitutes the basis for the UKC specifications that have been in force on the St. Lawrence waterways between Montreal and Quebec City since 1992. These UKC specifications, which were implemented for reasons of safety and environmental protection, are managed and enforced by Marine Communications and Traffic Services (MCTS) of the Canadian Coast Guard (CCG).

Climate changes predicted for the short and medium terms suggest that in future, the water level of the river could dip below the average more often 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 phenomenon of ship squat, with a view to optimizing the water column available for navigation, could offer a promising alternative to dredging, should the maintained depth of the waterway need to be increased to ensure the competitiveness of ports along the St. Lawrence.

The purpose of this project is to study the squat phenomenon of ships, using GPS-OTF technology for the purpose of re-evaluating the underkeel clearance standard in force on the St. Lawrence.

Phase I (2001-2002) consisted of a feasibility study that concluded that the GPS-OTF technology could be used to measure squat with good accuracy.

Phase 2 (2002-2003) involved an initial campaign of squat measurements conducted in December 2002. Analysis of the data gathered revealed some problems associated with the quality of the data measured with the GPS-OTF technology. In view of these results and technical problems encountered, phase 3 comprised of a study to improve the reliability and performance of the GPS-OTF technology during squat studies.

Phase 3 (2003-2004; 2004-2005) is ongoing and the results should conclude that the CCG's GPS-OTF system meets the squat measurement survey requirements. Tests will be conducted to validate the deployment scenarios for the various ships targeted in the squat study.

Phase 4 (2005-2006) 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 the 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. Québec Region (418) 648-7493
CG Branch : Navigation Services
Funding: CCG R&D Program \$783,300
Thales Navigation \$400,000
Schedule: Fiscal Year 2001/2002 – Fiscal Year 2006/2007
Project Number: GMJF3

Erosion-Sedimentation Model of the St. Lawrence River

The purpose of this project is to develop a modelling package comprising a numerical erosion/sedimentation model and a graphic interface. This model could be used to

- gain a better understanding of erosion, transport and sedimentation processes in the St. Lawrence under various hydrological and hydraulic conditions; and
- evaluate the potential impacts of navigation and of waterway maintenance on the environment (shore erosion and deposition of dredged sediments).

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.

The numerical erosion/sedimentation model, in development over the last several years in partnership with National Research Council's Canadian Hydraulics Centre (CHC), Environment Canada and the Science Directorate of Fisheries and Oceans Canada, is designed to 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.

For 2004-2005, the research team will use the model to analyse erosion and sediment transport processes based on various hydrological and hydraulic scenarios and evaluate the potential environmental impacts of navigation and waterway maintenance in terms of erosion and sedimentation.

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, P. Eng., Québec Region (418) 648-7493
CG Branch : Navigation Services
Funding: CCG R&D Program \$642,300
Schedule : Fiscal Year 2001/2002 – Fiscal Year 2005/2006
Project Number : FMCC3

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.

The objective of this project is to develop a year-round buoy that is visible 24 hours per day year round on the St. Lawrence River with full ice capability. This project is now in the fourth phase.

The initial phases of this project have collected, test trialed and analyzed critical issues involved in developing an effective all-season buoy. Key included the use of new materials, radar reflectors, lights, hydrodynamic behaviour, batteries, resistance to ice and level of service. The results are being used to develop a design criteria to build a prototype year-round buoy.

This year (phase four), a prototype buoy will be built and in situ trials conducted in the winter 2004-2005. Floats will be mounted to the buoy in the summer 2005 that will increase the buoy's visibility and stability in wind and currents. Data will be collected and analyzed to determine whether or not the buoy meets operational requirements. A performance report will be written and recommendations made.

The development of an all-season buoy will offer year-round lighted buoy service that marine users would like to see while at the same time substantially reduce CG costs in the service and maintenance of the buoys.

Contact:	Sylvie Pelletier, Québec Region (418) 648-7450
CG Branch:	Navigation Services
Funding:	CCG R&D Program \$872,000
Schedule:	Fiscal Year 2000/2001 – Fiscal Year 2005/2006
Project Number:	FJNF3

Large Scale Sewage Treatment Plan

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, Québec Region (418) 648-3208
CG Branch : Fleet
Funding: CCG R&D Program \$1,000,000
Schedule : Fiscal Year 2001/2002 – Fiscal Year 2005/2006
Project Number : FQAT3

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.

Below lists the projects NIF will fund within the budget level.

To obtain more information about these projects, please contact Janice Brasier at (613) 991-6123, CCG NIF Coordinator.

Project List Summary

PROJECT NUMBER	PROJECT TITLE	2004/05 Approved
FVHV6	Radio Channel Noise Reduction	120,970
FVHP6	Investigation of Leeway and Drift for Ovatek Life Rafts	329,604
FVHQ6	CCGA-P Marine Simulator Program	310,054
FVHU6	Life Raft Operational Performance Evaluation of Technology, Human Factors and Training Elements	424,507
	NIF – Total Approved	1,064,165

Radio Channel Noise Reduction

It is proposed to develop and test a near real-time voice enhancement system that can be operated as a call-check system to aid in the interpretation of voice data over noisy MF, HF and VHF communication channels. The Canadian Coast Guard has noted that in previous SAR incidents communication with persons in distress has been hampered by radio channel noise.

In the first phase of this project an algorithm for voice enhancement will be developed and tested on examples from previous recordings of SAR communications. The algorithm will be implemented on a dedicated hardware system, and provide interpretation of radio transmissions over noisy channels. Prototypes of this system will be provided to the five MCTS centres on the island of Newfoundland for evaluation by MCTS Officers over the course of the second year of the project. Feedback from the MCTS Officers will be considered for improvements during the evaluation phase of the project. A summary of the trials will be included in the final report.

Contact : Janice Brasier, (613) 991-6123
CG Branch : Search and Rescue
Funding: NIF Fund \$167,970
Schedule : Fiscal Year 2004/2005 – Fiscal Year 2005/2006
Project Number : FVHV6

Investigating Leeway and Drift in Ovateck Liferrafts

This submission seeks NIF funding support to carry out a leeway investigation of a relatively new type of SAR object (specifically, the Ovatek 4- and 7-person rigid life rafts (<http://www.ovatek.com/>) for which leeway speed and angle information is currently not available in the National Search and Rescue Manual (DFO, 1998) and the Canadian Search and Rescue Planning (CANSARP) program. Ovatek life rafts; which have SOLAS, CCG, and USCG approval; are becoming a popular alternative to inflatable life rafts on board fishing vessels in Atlantic Canada and the West Coast of North America.

A two-phase project is proposed for FY 2004/2005 and 2005/2006. In the first year, a field experiment will be conducted in coastal waters off eastern or northeastern Newfoundland using instrumented Ovatek 4- and 7-person life rafts. For each SAR object, two configurations will be used: fully loaded and equipped with a drogue and lightly loaded without a drogue. These configurations will provide minimum and maximum leeway speeds, respectively, for the given SAR object. The free drifting objects will be fitted with an anemometer system to record relative wind velocity, a fluxgate compass, Global Position System (GPS), air and sea surface temperature probes and an InterOcean S4 current meter to measure leeway directly. A directional wave buoy moored in the area of the experiment will provide wave data. This array of instrumentation will provide all the data necessary to evaluate the relationship between wind velocity and SAR object leeway. It is expected that leeway data will be obtained for wind speeds up to 25 to 30 knots during Phase I.

Following the 28-day field program, an analysis of the data will be conducted and an interim report issued. Phase I work will serve as a trial and test program for a more ambitious Phase II program in FY 2005/2006. In Phase II, two 4-person and two 7-person Ovatek rigid life rafts will be deployed on the Grand Banks for a month long field trial during the fall of the year. The SAR objects will be configured as in Phase I. The objective will be to collect leeway and drift data for the limiting load and drag configurations in wind speeds up to 50 knots, consistent with previous leeway work carried by the proponents.

Upon completion of the Phase II field program, an analysis will be carried out combining Phase I and Phase II data.

An objective of the analysis of leeway angle will be to increase the precision of the leeway angular dispersion by investigating the effects of longer averaging periods under the time-varying wind conditions. Increasing the precision of the leeway angular dispersion for SAR objects will serve to reduce search areas, search times, and SAR resource requirements. The project final report will be delivered by the end of FY 2005/2006.

Contact : Janice Brasier, (613) 991-6123
CG Branch : Search and Rescue
Funding: NIF Fund \$616,968
Schedule : Fiscal Year 2004/2005 – Fiscal Year 2006/2007
Project Number : FVHP6

CCGA-P Marine Simulator Program

The Canadian Coast Guard Auxiliary Pacific Region (CCGA-P) would like to develop and implement a new volunteer search and rescue (SAR) training program that employs emerging technology to improve the safety, efficiency, and cost-effectiveness of the existing SAR training program and the effectiveness of current marine SAR operations throughout Canada.

The technology that would be utilized in this program would also be used to educate the public in the fields of SAR prevention and boating safety.

All of the information gathered through the simulation project would be compiled and made available to other interested marine SAR organizations, and the CCGA-P will be available to assist these groups when necessary.

Contact : Janice Brasier, (613) 991-6123
CG Branch : Search and Rescue
Funding: NIF Fund \$346,726
Schedule : Fiscal Year 2004/2005 – Fiscal Year 2006/2007
Project Number : FVHQ6

Liferaft Performance During Evacuation, Rescue & Recovery

Liferafts are commonly used worldwide as primary or secondary means of evacuation from merchant ships, passenger vessels, fishing boats, and offshore petroleum installations. In many cases, liferafts are required by regulation or law whose explicit aim is to provide for the safety of life at sea.

Despite being almost universally prescribed for and carried by ships and offshore platforms, the actual performance that can realistically be expected of liferafts and the people who have to use them in practice is largely unknown. The absence of quantitative knowledge about liferaft performance – especially in different weather conditions – weakens rational decision-making processes governing a host of associated search and rescue operations and planning.

The proposed project will address this need by assessing liferaft operational performance in terms of technical capabilities in a range of weather conditions. The influence of external factors and mitigating measures on performance will also be evaluated. This includes the role of human factors and training. The outcome of the project will be practical knowledge that can promote survival and support operational decision-making, with the ultimate goal being to improve the safety of personnel who work on or travel by sea.

Contact : Janice Brasier, (613) 991-6123
CG Branch : Search and Rescue
Funding: NIF Fund \$991,129
Schedule : Fiscal Year 2004/2005 – Fiscal Year 2006/2007
Project Number : FVHU6