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ANNUAL REPORT 2008-09

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17. Abstract

The Canadian Coast Guard (CCG) annual report on its R&D activities, describing the research projects undertaken by the various branches and regions of the CCG during the fiscal year 2008-2009.

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2008/09 R &D FUNDING SUMMARY

CCG R&D PROGRAM			2008/09 Funding Summary ($000)			
PROJECT CODE	**GROUP/ GROUPE**	**PROJECT TITLE/ TITRE DE PROJET**	**Requested/Allocation**	**Funding Utilized**	**GAP**	**% Difference**
FVGV6	Project Director: Barbara O'Connell Project Officer: Jose Fernando Mojica Scientific Authority: Dr. Garry Timco (CHS)	Ice Hazard Radar Radar pour les risques des glaces	100	**26**	74	74%
FJNF3	Project Director: Daniel Crépault Project Officer: Georges Cossette Scientific Authority: Lise Dupuis	Lighted Spar Buoy L'Espar lumineux	120	**120**		
FJMP3	Project Director: Martin Blouin Project Officer: Stéphane Dumont Scientific Authority: Bernard Doyon, Ph.D.	Oil Dispersion in Ice-Covered Waters using Oil-Mineral Aggregates Dispersion des hydrocarbures sous la forme d'agrégats pétrole-argile dans des eaux encombrées de glace	60	**60**		
FQAG6	Project Director: Steve Peck Project Officer: Phillip Murdock	Vision Standards for Seagoing Personnel Vision standardisé pour le personnel navigant	25	**25**		
FQAP6	Project Director: Lynn Denis Project Officer: Stephanie Verbit (ITS)	Synthetic Mooring for Large Buoys Amarres Synthétique pour Bouée de Grande Dimension	53	**40.7**	12.3	23.21%
		Total	358	**271.7**	86.3	24.11%

ICE HAZARD RADAR

In 2008/09, the CCG developed a Statement of Work for the vertically-polarized slave scanner development. The "Request for Proposal" for the x-pol scanner development was issued in January 2009. The remaining SOW for the display development to be issued at a later date. A contract was awarded to OpDAQ in March 2009 to begin work on the construction of a cross-polarized radar scanner at a cost of $397,500 over three fiscal years.

By March 31, 2009, the contractor had produced the project work plan that will guide the development of the radar scanner. The Project Manager presented papers at two Canadian ice technology conferences to raise awareness of the high-speed radar development. CCG also acquired a spare component for the CCGS *Henry Larsen* radar. Due to unforeseen delays to the contracting process, the entire $100K was not utilized. The Project Manager requested that $74 be carried over into 2009/10.

LIGHTED SPAR BUOY

Furthermore, a cost-effectiveness study undertaken as part of AToN21 recommended in May 2008 the following scenario for the deployment of four-season buoys:

- Lac Saint-Louis and South Shore Canal: replacement of the 43 summer buoys (33 lighted and 10 unlighted);
- Montreal at the Traverse nord (pointe du Débarquement): replacement of the 321 summer buoys (292 lighted and 29 unlighted).

The status of the various stages of the R&D project is as follows.

1. Characterization of the physical environment

The specific objective of this stage is to establish as precisely as possible the environmental conditions that influence the behaviour of the buoys: depth, currents, waves, wind, ice, etc.

- Lac Saint-Louis and South Shore Canal: a first characterization was completed in 2006; it will have to be updated in 2009-2010 to take into account the deployment scenario recommended in the cost-effectiveness study.

- Montreal at the Traverse nord: an initial characterization was completed in 2007; it will have to be updated in 2009-2010 to take into account the most recent data from the deployment scenario recommended in the cost-effectiveness study.

2. Development and testing of four-season buoys in Lac Saint-Louis and the South Shore Canal

The specific objective of this stage is to develop a lighted spar capable of replacing the commercial channel buoys in Lac Saint-Louis. In 2005-2006, a lighted steel spar was developed by changing the plan of the standard buoy of the "0.7 m conical spar" type (plan FA-3004). The studies and tests showed that the lighted spar could not be used outside Lac Saint-Louis, because to meet behaviour criteria, the mooring conditions are limited to depths of less than 18 m and current speeds of less than 1.5 knots.

- Lighted steel spars of 0.7 m in diameter: three prototypes were constructed and tested in Lac Saint-Louis over a two-year period that will end in June 2009. Because a waterproofing problem was noted in the battery compartment on one of the prototypes, improvements will be made in 2009-2010 and new tests undertaken.

- Tests with new lighted plastic spars (model SVV500-6 from Sabik): tests were made with eight buoys (six in Lac Saint-Louis and two in the South Shore Canal) in order to compare their performance with that of the 0.7 m steel spars. The tests will be completed in June 2009.

3. Development and testing of four-season buoys for the other segments of the St. Lawrence River (from Montréal to the pointe du Débarquement)

The specific objective of this stage is to develop a new model of steel four-season buoy to replace those deployed below Montréal where environmental conditions are more severe than on Lac Saint-Louis.

- Feasibility study and preliminary design: with this stage a spar 1.3 m in diameter was developed and will be constructed in two lengths taking environmental conditions into account: the fluvial version (9.2 m) for the Montréal – Grondines segment, and an estuarian version (10.0 m) for the Grondines – Pointe du Débarquement segment.

- Lighted steel spars, 1.3 m in diameter for the Montréal – Grondines segment: two prototypes were built and moored in January 2008 for a two-year test period. Changes were made to the prototypes to improve the docking system and the battery compartment, as well as to eliminate oscillating about the longitudinal axis. The two prototypes behaved well during the winter of 2008-2009. The stability study of the buoy will have to be updated in 2009-2010 to ensure that the modified buoys meet performance criteria regardless of their mooring area.

- Lighted steel spars, 1.3 m in diameter for the Grondines – Pointe du Débarquement segment: the design will be finalized in 2009-2010, taking into account the improvements made to the Montréal – Grondines segment prototypes. Prototypes will be built and moored for a two-year period.

- Tests with a high-performance paint: two unlighted spars, 1.0 m in diameter, were painted with Inerta 160 and moored for a two-year test period that ended in November 2008. The tests showed that with the coating product the objective of the R&D project was achieved: the spars resisted two years without maintenance in conditions prevalent in the St. Lawrence. A summary report was produced.

- Battery problem: during the year, we had many Celtek battery breakdowns. Our inspections and studies of the prototypes revealed obvious weaknesses in the internal assembly of the cells. Although the watertight quality of the battery appeared reliable, its design did not seem capable of resisting the severe ice conditions on the St. Lawrence River. That is why we are now working to improve the battery by making use of regional expertise. To speed up the process, we intend to proceed with laboratory tests once improvements have been made.

- Solution for lettering: to come

Continuation of activities scheduled to complete this project depends on the human and financial resources available and allocated to the project during 2009-2010 and 2010-2011.

OIL DISPERSION IN ICE-COVERED WATERS USING OIL-MINERAL AGGREGATES

Tests at sea were completed in 2007-2008, thus concluding the experimental part of the study. The complete overhaul of the preliminary examination of the environmental risks linked to the tests, as well as the ER activities, certainly helped to obtain authorizations and permits from the various governmental jurisdictions involved. Preparation of the field campaign required the co-ordinated efforts of the 3 CCG branches (Integrated Technical Services, Marine Services and Operational Services). The testing procedure also had to be adapted to accommodate the sampling protocol of the Bedford Institute of Oceanography. All their manoeuvres had to be integrated into an overall experimental protocol. With the inclusion of the mobilization and demobilization stages, the field campaign lasted 1 week. It required 18 people, not counting the icebreaker crew, and considerable logistical needs had to be met.

The three tests were undertaken at the end of January 2008 and were aimed at simulating a very small oil spill. They helped us to determine to what extent the positive results obtained in the laboratory and within basins were transportable to the field. Processing of the data collected was completed during 2008-2009. The final version of the mission report is not yet finished. Preliminary observations with a fluorescence microscope conducted by COOGER specialists had confirmed the presence of COAs in samples collected during testing. Thus it was already established that it is possible to force the formation of COAs in a marine environment.

Once formed, COAs should be dispersed. As a complementary activity and part of a co-operative effort with the Total Chair of Process Technology and Engineering, digital simulations were used to help assess the potential dispersion of COAs. The work with the Total Chair has spread over 2 fiscal years (2007-2008 and 2008-2009). During the second and final phase of the agreement, the Total Chair specialists simulated the transport of particles whose properties resembled those of COAs formed in the field. Conditions in ice-free and ice-covered water were simulated for comparison purposes. Dispersion was simulated in a turbulent environment where agitation was recreated by the rotation of a digital propeller (figure 1). Simulations helped identify the optimal rotation speed to maximize the dispersion of COAs formed during the operation.

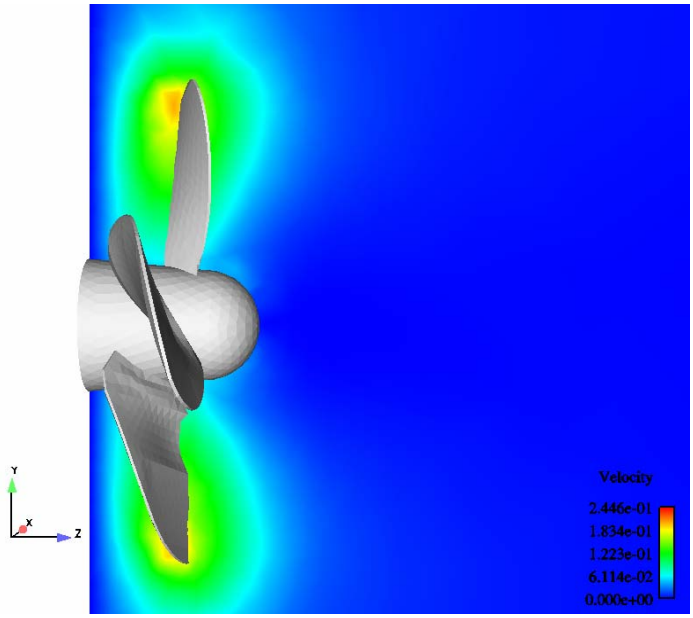

Figure 1: Propeller and speed field

Results of the COA formation process will be acceptable only inasmuch as the aggregates formed do not sediment close to the intervention location. It was therefore considered essential to produce a summary assessment of what we know about certain aspects of COAs to determine the risk of rapid sedimentation of the aggregates. Therefore, the CCG gave scientists from Environment Canada's Emergencies Science and Technology Section (ESTS) in Ottawa the mandate to list everything known about the clay-oil aggregate process. By so doing, CCG and ESTS researchers have started to identify gaps in our knowledge of certain physical characteristics of COAs and the impact of those gaps on the development of an operational method based on the stimulation of the process. The agreement is in two stages, covering fiscal years 2008-2009 and 2009-2010.

For the project's final year, plans are to complete the work scheduled for the second phase of the agreement with the ESTS. There are also plans to mandate researchers from the Total Chair to review certain findings of the study undertaken last year as part of the same project. This more in-depth investigation of the Total Chair study findings will help establish the theoretical limitations of a potential intervention technique using fine argillaceous sediments as natural dispersants. Finally, the intervention method guidelines will be released based on all the tests and studies completed during the project by the CCG or its collaborators, in particular the COOGER, the ESTS and the Total Chair researchers. The findings of the final report will also rest on recent work performed by other researchers.

VISION STANDARDS FOR SEAGOING PERSONNEL

As a first step towards posting and granting an R&D contract to commence research for a BFOR for vision standards for seagoing personnel, Marine Personnel was required to gather all information and reports made in the past 15 years. Due to critical turnovers in HR, the project was transferred to new key players and past work needed to be re-assessed. It was decided that to avoid future complications, all past R&D reports needed to be reviewed and reassessed to evaluate their relevance to today's new standards.

To do so, Phase I was established in order to outsource the analysis/review/benchmarking of these reports to external experts in the field of visual perception or visual experimental psychology. The funding received during fiscal year 2008-09 was used to establish the Terms of Reference and Evaluation Criteria for such a contract.

Fleet established a contract with Turpin Consultants Inc to establish MERX RFP terms and evaluation criteria for the upcoming 'Literature review/Benchmarking Scan, and Critical Assessment of Vision Standards' contract. These documents, including a list of organizations to invite in the bidding process, was compiled and completed in time for the end of the 2008-09 fiscal year.

Thorough Terms of Reference and Evaluation Criteria were developed and finalized. The bidding process by invitation / MERX posting will be completed early in the 2009-10 fiscal year as a follow-up to this work and to complete Phase I of this new initiative.

SYNTHETIC MOORING FOR LARGE BUOYS

This project consisted of a number of sub-tasks, all intended to contribute to the overall project goal of enabling the expanded use of synthetic moorings. These sub-tasks included the following:

a) development of synthetic mooring handling procedures;
b) continuation of residual strength testing of in-service synthetic moorings;
c) examination of accelerated life testing standards and procedures applicable to synthetic moorings; and,
d) investigation of synthetic mooring disposal options.

Another originally proposed sub-task, to investigate and optimize synthetic mooring design configurations for buoys using modeling and simulation techniques, was not undertaken due to funding constraints.

The development of the synthetic mooring handling procedures sub-task followed on from two earlier tasks pertaining to i) current CCG handling procedures, and ii) an assessment of industry practices, procedures, and tools. This task was contracted to Lansdowne Technologies who developed a comprehensive Technology Evaluation Plan (TEP), identifying candidate tools and techniques to evaluate, as well as detailed test and evaluation plans and procedures. The execution of these tests and trials is scheduled for the current fiscal year (i.e. 2009-2010). Note that a $2,918.85 + GST invoice against this task was incorrectly posted to an AToN21 T.I.E.S. tasking, contributing to the funding expenditure shortfall on FQAP6.

The residual strength testing of in-service moorings is an on-going activity aimed at quantifying the in-service degradation of synthetic moorings over time. The task was initiated in the Newfoundland & Labrador Region in 2007 and expanded to include samples from the Maritimes Region over the past fiscal year. Testing activities completed this past fiscal year consisted of the break testing of a number of Newfoundland region multi-season ropes at North Atlantic Marine Services and Supply in November 2008, the break testing of a number of 3-year old Maritimes region ropes at IMP Marine in December 2008, and the break testing of some additional Newfoundland region multi-season ropes at Extreme East Rigging in March 2009. The test results are currently being analyzed and aggregated with all previous test results. Further residual strength testing is planned as the synthetic mooring test population ages.

The accelerated life testing sub-task was divided into two smaller investigations. This was done to allow incremental reviews and assessments prior to the commitment of additional funding should the concept be deemed unfeasible. GasTOPS was initially contracted to research available industry test standards and industry test facility capabilities. The results of this preliminary investigation determined that while there were no directly applicable accelerated life industry test standards, there were a few potentially applicable cyclic fatigue test standards.

There was sufficient potential with at least one of these standards to examine its applicability, along with published cyclic fatigue life prediction correlations, further. GasTOPS Ltd. was subsequently contracted to analyze the applicability of the Thousand Cycle Load Limit (TCLL) test standard and the Banfield et al fatigue life design curve further in an effort/attempt to develop a practical accelerated life/cyclic fatigue test process for CCG synthetic moorings. The result of this analysis was the development of a test method to estimate the fatigue life of a synthetic mooring for one or two service load profiles. Further research and testing is required to expand the method to estimate the fatigue life of synthetic moorings for actual in-service load profiles and for service loads outside the range of the TCLL test method (50% - 100% design strength). Note that both of these taskings were incorrectly raised as AToN21 T.I.E.S. taskings, contributing $9,047.81 +GST to the funding expenditure shortfall on FQAP6.

The investigation of synthetic mooring disposal options sub-task was undertaken to address the end-of-life disposal issues surrounding the use, and expanded use, of synthetic moorings. This task was contracted to Genivar, a multi-disciplinary engineering and environmental consulting company. Genivar produced a technical report providing a description of the background and purpose of the project, an explanation of the research methodology, a discussion of the various material management options discovered based on the research completed, and a summary of priorities and a proposed action plan.

Based upon the above completed research and development activities, the Initial Guidelines for Synthetic Moorings Used with Small Buoys in Shallow Waters, 57-000-000-EG-TE-001, was updated and is currently in the technical review process. The revised guidelines are applicable to ⅝” and 1 ¼” synthetic moorings that have minimum breaking strength’s of 12000 lbs or 48000 lbs respectively and are intended for use with anchors weighting of up to 1134 kg (2500 lbs).

NEW SEARCH AND RESCUE INITIATIVES FUND

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. Its 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.

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

Approved R&D NIF Project Summaries

	Project Name / Recipient/Region	ID / # / Code	Summary	Cost
1	*POD Validation of Leeway and Drift*	*200709 DFO 6/07*	*Collect Probability of Detection (POD) data and determine the sweep width for 4- and 7-person life rafts using an All Weather SAR vessel tasked for SAR missions during poor weather during fall and winter in Eastern Canada. Extension of the collection of leeway data for the new Ovatek life raft.*	*07/08 504.278* *08/09 346,250* *TEC 850,528* *VOTE 10*
2	*Dev't. & Validation of Improved Ocean Drift Theory*	*200712 DFO 4/07*	*This proposal will address the prediction of drift and search area calculations currently undertaken by CCG and explore and recommend improvements in the form of a manuscript for submission to Coast Guard and the International Maritime Organization. The theoretical development and validation work will be complemented by a short field trial.*	*07/08 76,963* *08/09 60,000* *09/10 40,000* *TEC 176,963*