



Fisheries and Oceans
Canada

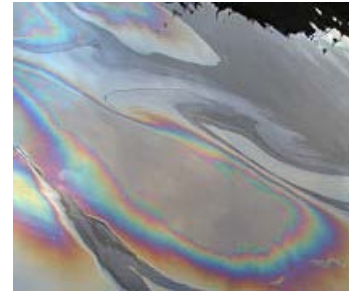
Pêches et Océans
Canada

Canadian
Coast Guard

Garde côtière
canadienne



Safety First, Service Always



Trends in Technology Development for Marine Spill Response

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CANADIAN COAST GUARD - ENVIRONMENTAL RESPONSE

Spill Response for the Future Conference
Stjørdal, Norway, April 8, 2011

Presentation Overview



- Roles and Responsibilities for marine oil spill response in Canada
- Canadian Coast Guard activities in oil spill technology R&D
- Strategic vision for marine pollution R&D

Presentation Objectives



- Present the role of Canadian Coast Guard in marine pollution preparedness and response;
- Present Canadian Coast Guard past and current R&D activities in oil spill response;
- Share observations on a recent intergovernmental initiative and approach to marine pollution science R&D in Canada.

Marine Pollution- A Multi-Agency Approach



- Canada's marine pollution preparedness and response system is a network of departments and agencies with prevention, preparedness, and response responsibilities delineated by source of pollution, and geographic location:
 - ***Canada's Marine Oil Spill Prevention and Response Regime (south of 60)***
 - ***Offshore Oil and Gas Regime***
 - ***Hazardous and Noxious Substances (HNS) Regime (proposed)***
- However, spills in the Arctic, small vessels spills, transboundary spills, and mystery spills are not covered by the Regimes.

Canadian Coast Guard Environmental Response

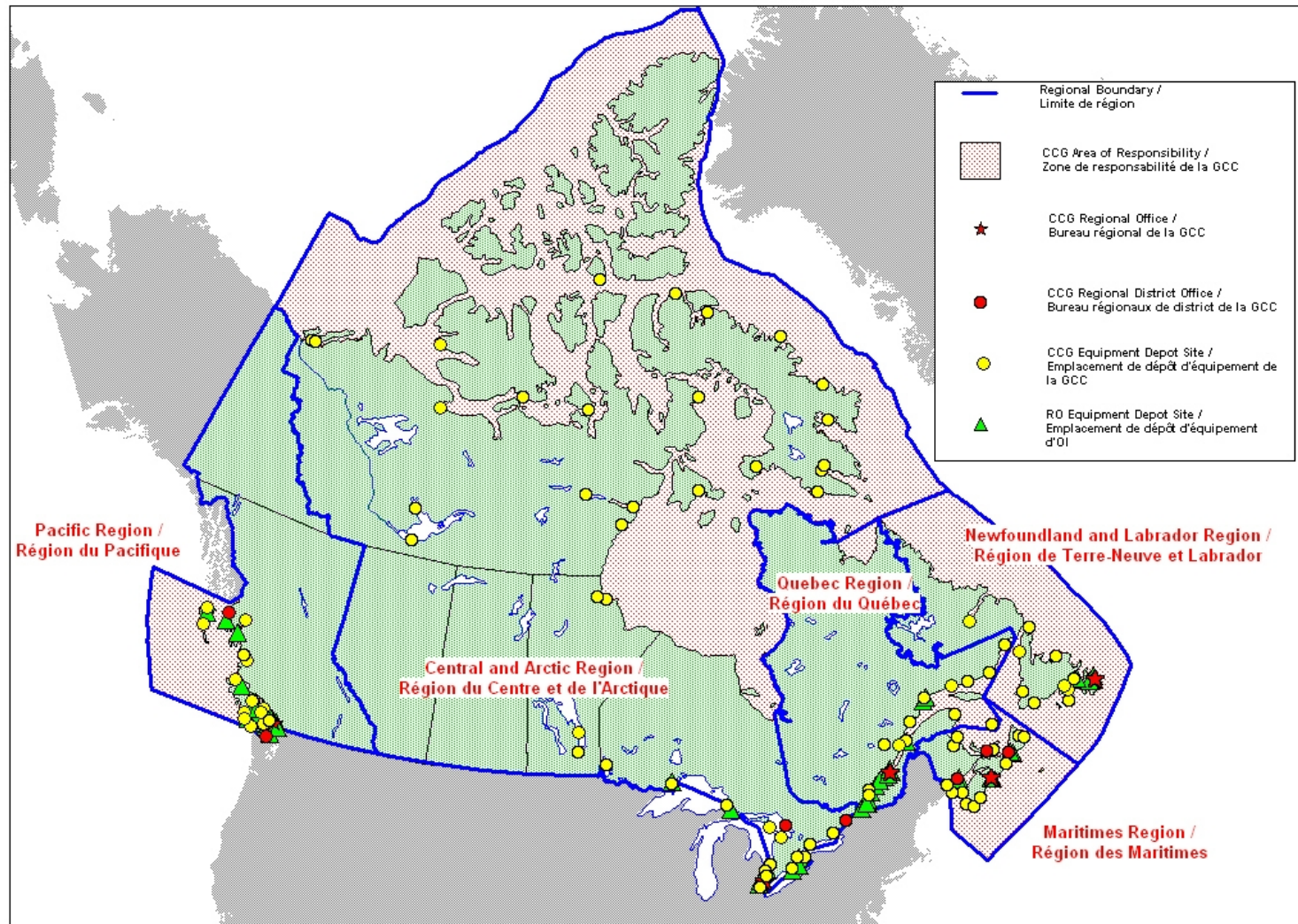


- Canadian Coast Guard is a Special Operating Agency of the Department of Fisheries and Oceans Canada
- Coast Guard is *lead federal agency* to ensure an appropriate response to ship sourced pollution in Canadian waters.
- Each year, the Coast Guard responds to ~ 1300 reported marine pollution events.
- Delivers on this mandate through the Environmental Response Program, with:
 - 75 trained responders located in 5 regions;
 - >80 caches of response equipment;
 - 19 Arctic Community Packs;
 - Specialized training in spill management and response;
 - National Response Team;
 - International agreements for response in contiguous waters (US, Denmark, France)

Canadian Coast Guard Environmental Response



CCG and RO Equipment Depot Sites / Emplacement de dépôt d'équipement d'IE et d'IO de la GCC



Delivering Environmental Response Services



1. *Federal Monitoring Officer (FMO)*

- CCG assumes the role of FMO to represent the Government of Canada's interests, protect coastal communities and the environment;
- As FMO, the CCG monitors the activities of the ship owner to ensure appropriate clean up actions are taken.

2. *On Scene Commander (OSC)*

- CCG will take over the response to a marine pollution incident if the ship owner is unwilling, unable, or unknown (i.e. mystery spills);
- CCG has trained people, equipment, vessels, and systems to respond to a variety of marine pollution events.

3. *Resource Agency*

- At the request of another federal department, board or agency, the CCG may use its people, vessels, or expertise to support the on-water mandate of our federal partners (e.g.. Swiss Air, Manitoba Floods)

Oil Spill Response



Supporting Flood Response



Polluter's Roles and Responsibilities



- In the event of a **ship source spill**, a ship owner or oil-handling facility operator may :
 - Clean up and recover the oil himself.
 - Activate his arrangement with a certified Response Organization or hire a response contractor.
 - Allow CCG to assume clean-up operations and bill the polluter.
- Polluters do not have to assume the role of OSC.
- Polluters are always liable for pollution damage as well as CCG's costs and expenses.



CCG and Oil Spill Technology R&D



- Why the interest in R&D?
 - As the “end users” of science, active participation in R&D initiatives is crucial to ensuring operational needs are met
 - Scientifically backed data required to ensure appropriate policies developed that reflect the needs and priorities of Canadians
- Historically Coast Guard R&D focus has been on:
 - Containment and mechanical recovery
 - In-situ burning
 - Shoreline clean-up
 - Large scale tank and field testing
- Coast Guard has partnered with other departments research institutes, and other governments and international institutes on many research projects in the past.



CCG and oil spill R&D



- Shifting priorities over the past decade has resulted in a decrease in R&D activities
- Recent R&D initiatives
 - Mechanical recovery
 - Improving skimming and pumping capacity for heavy viscous oil
 - Improving containment systems
 - Shoreline clean-up
 - Implementing findings from field trials
 - Oil Mineral Aggregates
- R&D findings applied to actual spill incidents



Recent R&D initiatives – Mechanical Recovery



- Mechanical recovery
 - Viscous Oil Pumping System/
Annular water injection
 - Brush skimmer adaptors
 - Magnetic Ship Joint for
Sweeping Systems
 - NOFI Ocean Buster Integrated
System



Canadian and U.S. Coast Guard personnel preparing a CCG GT185 pump for testing (JVOPS)

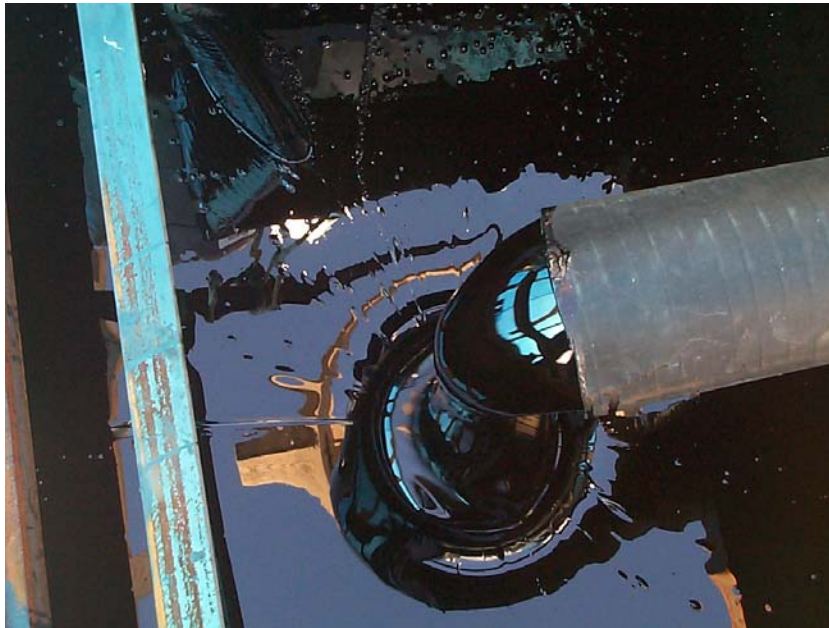
Joint viscous oil pumping system



Concept: Using water lubrication technology to reduce system pressure and increase pumping distance and flow rate.

Annular Water Injection Flange: Meters lubrication water into the discharge side of a standard lightering pump. The flange forms a water “ring” around the heavy viscous product, “tricking” the pump into thinking it’s pumping water.

Viscous oil pumping system



Water Lubrication: Shown on left is un-lubricated test product flow. On right is lubricated flow.

Results: Initial review of test data indicated that standard lightering pumps with the aid of water lubrication, may be able to pump heavy viscous product at **25 times the flow-rate and distance** than without lubrication.

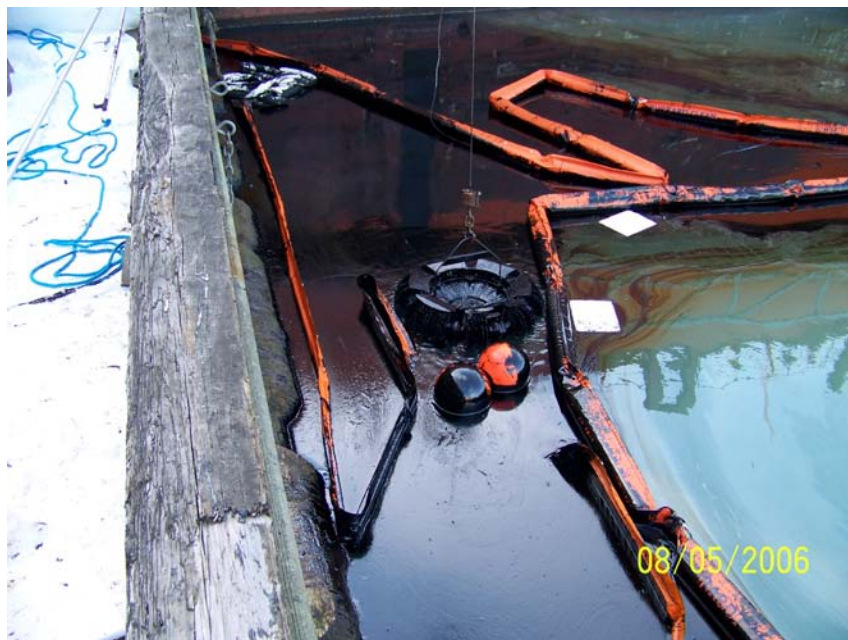
GT 185 Brush adapter for viscous oils



- The GT 185 with Desmi Helix Brush adapter was tested as part of a program to test viscous oil recovery capabilities of currently stocked skimmers at CCG bases in Canada
- Significantly improved recovery rates were achieved



Modified skimmers used in actual spill response



- The GT 185 with brush adaptors was used during the response to a spill of Bunker C.
- High recovery rates were achieved

Recent R&D initiatives – Shoreline Cleanup



- Shoreline Cleanup
 - Focus on methods requiring little infrastructure support and that generate minimal waste, especially for Arctic or remote areas
 - Key techniques studied included sediment relocation (surf washing), tilling, bioremediation, beach flushing
 - Implemented findings from field trials during response to spill responses



Svalbard Field Trials – 1996/98

Shoreline Cleanup



- Techniques used during a spill response in Canada
- Removal of Bunker C from mixed sediment shorelines
 - Tilling
 - Sediment relocation
 - Flushing



Shoreline Cleanup



Once bulk oil removed, shorelines in a high silt, high energy environment left to recovery naturally





Oil Mineral Aggregates

- Based on the concept of transferring oil from the sea surface into the water column, as small oil droplets
- These are diluted by natural processes to concentrations below toxicity threshold limits
- Dispersed oil droplets are degraded more rapidly by natural bacteria
- Achieved with chemical oil dispersants and/or facilitation of oil mineral aggregate formation
- CCG tank testing in Winter 2008



St. Lawrence Estuary Field Trial: DFO Science/CCG



**Test effectiveness
OMA formation as
a oil spill
countermeasure**

**Fill the gap
between lab and
real-world
application**

**Gain operational
experience for
larger scale field
trials**

*** Controlled release of oil**



OMA Application and
Mixing Treatment



Summary – OMA field trials



- Oil spilled on ice-covered waters may be effectively dispersed by promotion of OMA formation.
- Allows for the effective dispersion of small volumes of spilled oil
- Propeller wash can provide sufficient mixing energy to facilitate OMA formation.
- For most test cases (except under very weak currents), only a small fraction of the spilled oil may enter the sediment.
- The settled oil will spread to a large extent → low concentration.
- The risk level is very low (Hazard Quotient<1) due to low concentration.
- OMA properties, such as particle size is important factor which determines the ultimate risks.
- Risk increases under very weak current conditions and in shallow water environment.
- The biodegradation rates of settled oil are very slow.
- Ongoing wave tank and numerical model studies are focused on the influence of factors such as mixing energy, type of mineral fines, chemical dispersants and toxicity issues.



DFO at the Deepwater Horizon spill



- **Plume Monitoring and Assessment for Subsurface Dispersant Application (US EPA Directive – May 10, 2010)**
- **Proof of Concept**” to determine if subsurface dispersant operation is chemically dispersing the oil plume.
- Robust sampling to **detect and delineate the dispersed plume** based on the results of PART 1 and input from hydrodynamic modeling
- DFO COOGER was requested by US EPA to provide scientific expertise to implement the directive



Future of Dispersant Use



- The ability to effectively deploy and monitor an unprecedented dispersant response in the GoM was based on the past decades' improvements
- Misperceptions and knowledge gaps over their use remain. Areas for improvement include:
 - Need to be a common understanding of the risks and benefits of dispersant use, as well as the safety and effectiveness of dispersant products.
 - Additional research is needed on the behavior and long term fate of dispersed oil in the water column when dispersants are applied at the sea floor.





- Assessing the current situational context
 - Challenges
 - Changing priorities
 - Funding availability
 - No single federal agency with R&D oversight
 - Opportunities
 - Recent events have raised the profile of oil spill response (DWH, groundings in Canadian Arctic)
 - Recent initiatives toward 'whole of government' collaborative efforts in marine pollution issues, including Science and R&D.
 - CCG has the ability to provide in kind support and expertise



- Improving collaboration in the federal government through an *Interdepartmental Committee on Marine Pollution*
- CCG (chair), Transport Canada (co-chair), Environment Canada, Natural Resources Canada, Indian and Northern Affairs Canada, Public Safety Canada, National Defence, and Fisheries and Oceans.
- The Committee provides a forum to facilitate a systematic approach to collaboration among federal marine pollution response and regulatory agencies
- **Interdepartmental Science R&D sub-committee**
 - Interdepartmental forum created to facilitate and coordinate collaboration and communication on marine pollution science R&D.
 - Roles and function include to:
 - Identify, review and provide advice on emerging and priority issues related to marine pollution
 - Improve the quality of science and minimize duplication of research effort
 - Develop and maintain connections with regional, national and international groups involved in marine pollution research
 - Facilitate collaborative research and information exchange on marine pollution R&D nationally and internationally



- R&D Priorities for Canadian Coast Guard and the Department of Fisheries and Ocean





- Focus research efforts on generating sound data that enable the development of effective environmental response policies and support decision making during a spill response
- CCG has identified the following priorities for future R&D:
 - Development of remote sensing systems to detect, monitor and map the transport and spreading of oil in ice and below ice
 - Verification of drift and fate models for oil in ice / Arctic conditions
 - Improved mechanical response systems for viscous oils and oil in ice
 - In-situ burning in broken ice and open water environments (development of fire booms, chemical herding agents, and ignition systems)
 - Enhancement oil dispersion (chemical dispersants/OMA) with focus on effectiveness, identification of controlling factors and development of application guidelines
 - Characterization of water soluble components of hydrocarbons and their biological effects (toxicity) on Arctic species
 - Development of operational end-points for spill clean-up operations
- Much focus on technologies that will improve for response capabilities in ice and in remote / Arctic areas.

DFO Research Priorities



National Research Council (NRC) Committee on Understanding Oil Spill Dispersants: Efficacy and Effects (2005) Identified two major uncertainties regarding dispersant use at sea:

- Dispersant efficacy at different sea states is not clear
- Biological effects of dispersed oils are poorly understood factors to be addressed in oil dispersant efficacy studies:



BIO wave tank facility constructed in collaboration with US EPA and co-funded by NRCan, NRC, NOAA, MMS, Cedre, etc.)



Future trends in technology development aim to promote science and research, reinforce cooperation, and strengthen partnerships

- Most of what we know about oil spill behavior and response to spills in ice comes from laboratory, experimental test tank studies, and a few historical large-scale field experiments
- The *operational effectiveness* of numerous “new” oil spill clean-up technologies and response strategies is unknown
- Proof-of-concept and operational guidelines must be established before they are accepted by the oil spill response community
- Conclusion of numerous scientific symposia on Arctic oil spill response - *Field trials with oil are essential to make real progress*

Questions?

