Backgrounder

Backgrounder

These R&D projects are funded under RDC's Leverage R&D, ArcticTECH, Collaborative R&D, and Ignite R&D programs. The backgrounder provides information about the individual projects funded under this announcement.

Leverage R&D

Leverage R&D attracts public funding for academic-led research and development in areas relevant to both industry and the Newfoundland and Labrador economy.

1. Sensing System for Detection and Tracking of Oil in Marine Waters in Harsh Climates

Dr. Christina Bottaro and Dr. Erika Merschrod, Department of Chemistry, Faculty of Science, and; Dr. Kelly Hawboldt, Faculty of Engineering and Applied Science

As Newfoundland and Labrador's offshore oil and gas industry continues to thrive, there is a growing need for improvements to oil spill detection technology. Dr. Christina Bottaro, Dr. Kelly Hawboldt, and Dr. Erika Merschrod are developing a sensing device that can collect and analyze data in remote locations to determine whether water is contaminated. This technology is suitable for data collection in marine waters including in harsh, Arctic environments. The sensor may be deployed in the vicinity of an oil platform, on production vessels, supply vessels, Autonomous Underwater Vehicles (AUVs) and/or Remotely Operated Vehicles (ROVs) to provide spill detection coverage. If this project is successful, this device will enable companies to detect oil spills in near real-time. **RDC's investment is $300,000 with total project costs of $3,056,792.**

2. High speed thermal imaging system

Dr. Yuri Muzychka, Dr. Lesley James, Faculty of Engineering and Applied Science

This project builds capacity at Memorial University through the purchase of new research tools to be made available to numerous departments at Memorial including the Chemistry Department, Computer Science Department and the Faculty of Engineering and Applied

Science. This purchase is for a high frame rate infrared (IR) camera that will be used to collect thermal images of many engineering systems and processes including: microelectronics systems cooling, winterization of marine systems, thermal energy systems, integrity/quality of pipeline welds, and oil and gas processing systems. This camera will directly support the research of Drs. Yuri Muzychka and Lesley James in the modelling of thermal transport processes, improving pipeline integrity, and developing enhanced oil recovery processes. **RDC's investment is $96,416 with total project costs of $192,847**.

3. **Infrastructure for the characterization of particulate matter and dissolved chemical species in water, soil and groundwater environments**
   Dr. Tao Cheng, Department of Earth Science, Faculty of Science, and; Dr. Bing Chen and Dr. Baiyu (Helen) Zhang, Faculty of Engineering and Applied Science

This project will continue to improve R&D capacity in the mining and energy industries through the purchase of a NanoSight Nanoparticle Characterization System and a Dionex Ion Chromatography (IC) System which will be housed in the Earth Resources Research and Analysis (TERRA) facility. This specialized equipment has the capability to help study nanoparticle measurements, dissolved inorganic ions and organic species in water samples. This equipment will directly benefit the research of Drs. Tao Cheng, Baiyu Zhang and Bing Chen in the areas of nanoparticle mobilization, offshore oil spill control and oil spill and offshore produced water treatment respectively. As well, this infrastructure will benefit other Memorial researchers indirectly, as well as over 50 students who will be trained by the researchers. **RDC's investment is $61,777 with total project costs of $148,583.**

4. **Compositional and isotopic characterization of complex organic samples for the study of origin and preservation of hydrocarbons and biological tissues**
   Drs. Penny Morrill, Vaughan Grimes and James MacQuaker Department of Earth Science, Department of Archaeology

This project supports the purchase of new instrumentation to characterize biological material, organic compounds, and mineral/ore-forming fluids. The equipment will be housed in the Earth Resources Research and Analysis (TERRA) facility in the Department of Earth Sciences, and is the only equipment of this calibre in Atlantic Canada. This new infrastructure builds capacity at Memorial that is relevant to the Province's energy sector, specifically the oil and gas industry, and will directly benefit the research of Drs. Penny Morrill, Vaughan Grimes and James MacQuaker. In addition, these researchers have identified that a total of 56 highly qualified personnel will be trained on the new infrastructure in the TERRA facility in the next five years. **RDC's investment is $110,212 with total project costs of $277,230.**

ArcticTECH

ArcticTECH is a three-year directed research program intended to enhance research and development capacity, collaboration and industry innovation in support of Arctic technology development.

5. Permafrost thaw and frost heave effects on Arctic pipelines
Dr. Bipul Hawlader, Faculty of Engineering and Applied Science

Pipelines in Arctic and northern regions are often buried and pass through long distances of varied soil types in terms of frost susceptibility. A reliable method that predicts frost heave and thaw settlement of permafrost and their effects on pipelines is required for Arctic pipeline design. Dr. Bipul Hawlader is developing a numerical tool for modeling frost heave and thaw settlement. If this project is successful, Dr. Hawlader's work will support Arctic pipeline designers. **RDC's investment is $121,600 with total project costs of $189,000.**

6. Weatherproof satellite data communication devices and application.
Dr. Lihong Zhang, Faculty of Engineering and Applied Science

This project will research weatherproof anti-interference satellite data communication techniques that will be investigated from both hardware and software perspectives. Most commercially available satellite modems can only operate in weather above 0° Celsius, with the exception of a few capable of operating in temperatures around -40° Celsius. Reliable communications and data collection are of high importance due to limited infrastructure in the Arctic. Dr. Lihong Zhang is developing cold-compliant satellite data communication devices that will work in super harsh environments with the ability of tolerating Arctic electromagnetic interference. If successful, this project will result in a weatherproof satellite modem prototype with an application in environmental monitoring for Arctic oil and gas exploration. **RDC's investment is $246,000 with total project costs of $301,600.**

7. Arctic Sparrow
Dr. Siu O'Young, Dr. Luc Rolland and Dr. Weimin Huang, Faculty of Engineering and Applied Science

Building on the developments of the RAVEN II (Remote Aerial Vehicle for Environment-monitoring) project, Dr. Siu O'Young is developing an autonomous navigation system for small

unmanned aircraft that will be able to perform special operations in maritime surveillance. If this project is successful, it will contribute to Arctic energy exploration through its abilities to detect ice movement, oil spills and mammalian movement. **RDC's investment is $245,000 with total project costs of $445,000.**

8. Modelling of Corrosion Under Insulation (CUI) in Offshore Petroleum Applications in Harsh Arctic Environments to Develop Risk-based Life Assessment for Asset Under CUI Attack

Dr. Faisal Khan, Faculty of Engineering and Applied Science

Corrosion Under Insulation (CUI) is a serious issue for offshore oil and gas production and transportation facilities in harsh marine environments. Corrosion damage can have catastrophic effects on health and safety, the environment, and productivity if it is not discovered before infrastructure degrades to a level that threatens containment. In collaboration with Husky Energy, Dr. Faisal Khan's project will increase knowledge in the prediction of CUI behavior to better anticipate the need to perform early and effective maintenance on the facility. Successful completion of this project will result in an online electrochemical corrosion measuring system that could be used as an evaluation and monitoring mechanism for the offshore industry and also model for maintenance management for CUI related threat. The field work will be located at RDC's coastal exposure test site in Argentia. **RDC's investment is $247,600 with total project costs of $373,600.**

Collaborative R&D

Collaborative R&D increases research and development partnerships and collaboration between academia and industry in areas relevant to the Newfoundland and Labrador economy.

9. Enhanced ozonation treatment for offshore produced water effluents

Dr. Bing Chen, Dr. Tahir Husain and Dr. Baiyu (Helen) Zhang, Faculty of Engineering and Applied Science

Preserving and protecting the natural environment is a high priority in the Newfoundland and Labrador petroleum industry. This project aims to solve the issue of produced water (PW), which is water extracted from a subsea oil and gas reservoir during production that can contain oil and toxic compounds and can present an environmental risk. With increasingly stringent guidelines for offshore wastewater disposal, Dr. Bing Chen is developing a cost-effective and environmentally friendly method for treating the toxic contents of PW to ensure that it is treated

and disposed of in a manner that ensures the protection of the marine environment. **RDC's investment is $57,694 with total project costs of $115,388.**

10. Extending functionality of evacuation systems in ice
Dr. Brian Veitch, Husky Energy Chair in Oil and Gas, Faculty of Engineering and Applied Science

The aim of this project is to extend the functionality of existing marine evacuation systems to work in ice conditions that are currently deemed to be beyond operability limits. In such conditions, the emergency response plan may call for precautionary measures to be taken such as halting production until ice conditions subside, and precautionary down-manning, which may be costly and involve risks to personnel. This project will use a simulation environment to demonstrate the level at which current evacuation systems are functional, incorporating standby vessels to clear pack ice and break navigable channels in intact ice sheets. If this project is successful, it may decrease the costs associated with evacuation and could potentially extend drilling or production activities in ice conditions. **RDC's investment is $95,051 with total project costs of $420,664.**

11. Development of biosurfactant-based dispersants and associated technologies for offshore oil spill control in harsh environments
Dr. Baiyu (Helen) Zhang, Faculty of Engineering and Applied Science

In the event of an oil spill, dispersants are often used to break up the oil into small droplets which can then be naturally dissolved and degradated. Oil spill response using dispersants has been proven effective, but is currently known to cause a degree of environmental harm. For this project, Dr. Baiyu Zhang is developing environmentally friendly dispersants which will be specifically designed for harsh environments. If successful, it could provide industry with cost-effective and environmentally friendly products and associated application technologies for oil spill response. **RDC's investment is $190,281 with total project costs of $381,281.**

12. Validation of ship design practices including pressure-area scale effect and extreme design forces using full scale measured ship ram data
Freeman Ralph (PhD Candidate, M. Eng. P. Eng), C-CORE

Evidence suggests that current shipbuilding practices and regulations for the design of the highest Arctic class vessels are highly conservative. This affects the economic viability of transportation through Arctic waters. With the growth in Arctic shipping expected to increase in

the coming years, industry needs to be able to meet this growth without compromising safety of life at sea or the sustainability of the Arctic environment. Mr. Freeman Ralph and Dr. Ian Jordaan with a team of ice experts at C-CORE will conduct a comprehensive validation study using available full scale measured ship ram data. The aim is first to ensure safety of arctic shipping and marine operations and then to determine if the current practices and policies are too conservative. If successful the project may lead to improved ship design requirements for Arctic vessels and be a major influence on the development of an international ship design code that balances both safety and economy. Beneficiaries of this work include arctic shipping industry stakeholders, including oil & gas and mining companies. **RDC's investment is $125,700 with total project costs of $387,020.**

Ignite R&D

IgniteR&D attracts highly-qualified academic researchers and builds new research and development capacity in areas relevant to both industry and the Newfoundland and Labrador economy.

13. Health and fitness demographics of workers in the Newfoundland and Labrador offshore oil and gas industry

Dr. Kevin Power, School of Human Kinetics and Recreation

As stated in a 2012 report by Statistics Canada, Newfoundlanders and Labradorians have the highest rate of obesity in Canada. At this time, it is unclear what the obesity rates are of workers within the offshore oil and gas industry specifically, and what the implications are for their at-work safety. Dr. Kevin Power is addressing these concerns in collaboration with Definitions, a local health and wellness provider for Newfoundland and Labrador offshore oil and gas companies. Anticipated long term outcomes include: reduction of injury rates and loss of offshore job production through enhancing health and wellness; development of fitness standards specific to offshore industry jobs; and, development of a behaviour change program to encourage and promote physical activity and healthy lifestyle behaviours for current and future employees. **RDC's investment is $100,000.**

14. Towards cleaner energy and environment: The case of metal-organic network solids

Dr. Chen Liu, Division of Science (Environmental Science), Grenfell Campus

Metal-organic network solids are a class of molecule-based materials that are being studied for their properties in gas adsorption, magnetism, catalysis, and separation. These properties may find applications in a variety of issues in environmental and energy sectors, such as sequestration of carbon dioxide, cleaner alternatives to fossil fuels, isolation of oil in water, and novel magnetic materials. This project is aimed at preparing metal-organic network solids in a more rational and controlled fashion and exploring the relationship between their structures and properties. **RDC's investment is $30,119.**

15. Seasonal break-up and drift of the outer coastal ice along the southern Labrador ports
Dr. Ian Turnbull, Centre for Arctic Resource Development (CARD), C-CORE

Shipping routes along the coast of southern Labrador are becoming increasingly important for nickel shipments and possibly future oil and gas shipments. Coastal ice break-up often blocks vessel transit coming from the Labrador Sea to harbours within this region. At this time, the seasonal timing and drift patterns of ice break-up are not well understood making it difficult to determine when to start and stop shipping, while maximizing safety. This project will monitor ice drift and break-up, and analyze satellite imagery to capture timing and spatial patterns of ice drift. Successful outcomes of this project will benefit the shipping industry through predictive models that will help maximize the operational shipping window while ensuring the highest level of safety. **RDC's investment is $100,000.**

16. Experimental and Numerical Investigation of Multiphase Pipeline Flow Scaling
Dr. Mohammad Rahman, Faculty of Engineering and Applied Science

Development and transportation of oil and gas production is challenging in offshore NL due to the harsh environment. In this environment, there is significant heat loss from multiphase flow pipelines, leading to a temperature drop in the pipeline fluid. The drop in temperature can lead to pipeline blockages due to the formation of gas hydrates, wax deposits or scales. While the formation of hydrates is an issue, there is also the issue of pressure loss and the spatial distribution of the pipeline flow components (flow regime). This research will address these issues through developing computational fluid dynamics (CFD) models and performing laboratory experimental analysis of multiphase flow. The outcomes of this research will provide the oil and gas industry with recommendations on offshore pipeline and wellbore designs. **RDC's investment is $99,600.**

17. Design optimization and manufacturing of cost-effective ship superstructure for harsh environment

Dr. S. Nakhla, Faculty of Engineering and Applied Science

This project will assess and select composite materials suitable for harsh environments and determine manufacturing techniques that will reduce the cost of developing these composite structures. This research can lead to improvements in the areas of shipbuilding, wind turbines and aerospace, and will develop highly qualified personnel for employment in local industry. **RDC's investment is $95,000.**