
OERA Offshore Energy Research Association

OERA funds & facilitates collaborative offshore energy & environmental R&D including the examination of renewable energy resources and their interaction with the marine environment.

Offshore Energy Research Association of Nova Scotia (OERA) is an independent, not-for-profit organization.

Our mission is to lead environmental, renewable, petroleum and related energy research that enables the sustainable, and responsible development of Nova Scotia's offshore energy resources through strategic partnerships with academia, government & industry.

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**Dr. Richard Isnor**
Associate Vice President, Research and Graduate Studies; St. Francis Xavier University, Antigonish, NS

# Chair's Report

Over the past year, the Offshore Energy Research Association (OERA) has continued to build on more than a decade's worth of research success, collaboration and impact in generating knowledge to enhance our understanding of Nova Scotia's offshore energy resources.

With the participation of the provincial government, private sector, five research intensive universities, and the Nova Scotia Community College, OERA has remained focused on harnessing the necessary expertise required to assess and develop our offshore energy resources, as well as address key social and environmental questions related to offshore energy development. The OERA has continued to play a major role in helping to build Nova Scotia's research capacity and is helping to train a new generation of energy research professionals in our province. OERA has also continued to cultivate international partnerships and collaborations relevant to the offshore energy research expertise and interests of Nova Scotia. Finally, OERA has attracted significant external research investments to effectively lever provincial government investments made in offshore energy research.

The entire Board of Directors for the OERA is focused on ensuring that the organization's research efforts and initiatives remain relevant, strategic, and responsive to the knowledge and decision-making needs of a variety of industry, government, and public stakeholders involved in our offshore energy sector. In my role as a Board member and Chair, I would like to thank the entire staff of the OERA for their hard work and professionalism as they continue to advance these efforts.

# Message from Executive Director

**Stephen Dempsey**
Executive Director
Offshore Energy Research
Association of Nova Scotia

Three themes come to mind I look back over the past year at the OERA – Research Excellence, Funding Leverage and Relationship Building. Each of these themes illustrated below are the core pf everything we do and are covered in more depth in the body of this Annual Report.

**Research Excellence**
The OERA team was very busy during the past year reviewing a record number of proposals, interacting with peer reviewers to select the best research initiatives and securing funding commitments to implement these important projects. Our proposal selection process balances the joint requirements of closing critical knowledge gaps within the marine renewable and petroleum sectors, while at the same time building research competence at the provincial level.

**Funding Leverage**
Recognizing that a small organization such as the OERA cannot possibly provide all the funds required to support a complex research agenda such expanding the Play Fairway Analysis (across the entirety of the Nova Scotia Offshore Petroleum Sector), or enable the responsible development of the emerging Tidal Industry (in the areas of environment impacts, cost reduction technologies or specialized marine operations), seeking relationships with other funders becomes a mission critical endeavor. Significant progress was made during the past year to address immediate funding requirements and lay the ground work for future partnerships.

**Relationship Building**
One of OERA's unique core competencies is understanding how to identify, develop and sustain relationships necessary to close the knowledge gaps within the offshore energy sectors. To be effective we must understand the requirements of local government and regulatory agencies, the priorities of national funding / granting agencies, and the motivations of industry and international research enterprises. The research collaboration results of the past year clearly demonstrate that OERA is a trusted and respected partner, and that our team members are the key to that effectiveness.

I am honored to have the opportunity to work with such a talented and dedicated team of professionals at the OERA and with our partner organizations during the past year; much has been accomplished, and yet there is still more interesting research to be completed as we work to reduce risk, attract investment and develop our offshore renewable energy resources in a responsible and sustainable fashion.

# Who We Are

The Offshore Energy Research Association of Nova Scotia (OERA) was established in March, 2006 and operates as an independent not-for-profit contract research association. OERA's mandate is to foster research and development initiatives related to offshore petroleum and renewable energy resources; their interaction with the marine environment, and the diffusion of that knowledge to key stakeholder groups. Our vision is to be the leading energy research organization in the country, providing efficient, timely and strategic solutions to complex research challenges. OERA membership includes the Nova Scotia Department of Energy, Acadia University, Cape Breton University, St. Francis Xavier University, Dalhousie University, Saint Mary's University, and the Nova Scotia Community College.

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**Industry / Business Representation**

*“FORCE, as the leading center for tidal energy testing in Canada, regularly collaborates with industry and academia in undertaking new projects that aim to address critical research questions impacting the sector. OERA has participated in a number of these projects, bringing funding, scientific understanding and focus to our common research efforts – their support has been fundamental to the responsible exploration of this new renewable energy source.”*

- Tony Wright, General Manager - Fundy Ocean Research Center for Energy (FORCE)

# Open Research Calls

While OERA has developed a robust process to set research priorities through direct interaction with government, industry and academic stakeholders, it is also necessary to accommodate for research proposals on subjects that OERA has not previously anticipated.

The Open Call program provides for innovative research projects to be submitted for funding consideration without the OERA initiating the request. Two intakes per year provide an effective conduit, connecting unique research ideas, supporting the closing of knowledge gaps and the development of innovation and new approaches to developing our offshore energy sector.

Below is a summary of the projects funded through the Open Call Program for last year:

## *Palynology and geochemistry of the Triassic-Middle Jurassic of the ArgoF38 well*

**Dr. Andrew MacRae, Saint Mary's University**
Collaborators: Stephen Rankin, Saint Mary's University

Triassic to Early Jurassic age rocks of offshore Nova Scotia record the earliest phases of the opening of the Atlantic Ocean, and are some of the oldest rocks relevant to petroleum exploration in the offshore. The 2011 Play Fairway Analysis hypothesized the existence of an Early Jurassic age, oil-prone source rock in the deeper water offshore. Formation of a source rock would relate to conditions in the narrow ocean that existed during these times, but the location and character of such a source rock are unknown due to lack of well penetrations in the deepest parts of the basin and a poor understanding of the ocean environment at the time these rocks were hypothetically being deposited. A more thorough study of the ancient environments around the edges of the basin will help us understand what was happening in its center.

The proposed study will focus on the best section through rocks of this age, located in the Argo F-38 well on the eastern Scotian Shelf. Due to the harsh environments at the time (desert landscape and salt basins), palynology (the study of fossil pollen, spores, and algae) is the only effective fossil technique for determining the age and past environment.

## *Advancing tidal energy turbine operations through high fidelity tug propulsion and control simulation software*

**Mr. Dean Steinke, DSA Consulting**
Collaborators: Adam Turner, AJ Baron and André Roy, DSA Consulting

The project objective is to develop a numerical model of a tug boat and its propulsion system to accurately predict its dynamic behaviour in turbulent tidal flows. The DSA team will develop new software for use by industry to improve tug/barge vessel simulation fidelity in high flow marine environments. Specifically, the advanced simulation capability will be used to optimize turbine deployment, installation, maintenance, and retrieval operations in predicting power requirements, thrust and dynamic response. The simulations will help support decision making in reducing operational costs and decrease risk. The project team will work with Black Rock Tidal, Open Hydro, and Atlantic Towing to ensure the new software capability will effectively address industry needs.

## *Measuring the acoustic detection range of large whales using an autonomous underwater (Slocum) ocean glider to improve an acoustic whale alert system for use by the offshore marine industry in Atlantic Canada*

**Dr. Chris Taggart, Dalhousie University**
Collaborators: Hansen Johnson, Dalhousie University, Dr. Mark Baumgartner, Tenure, Woods Hole Oceanographic institution (WHOI)

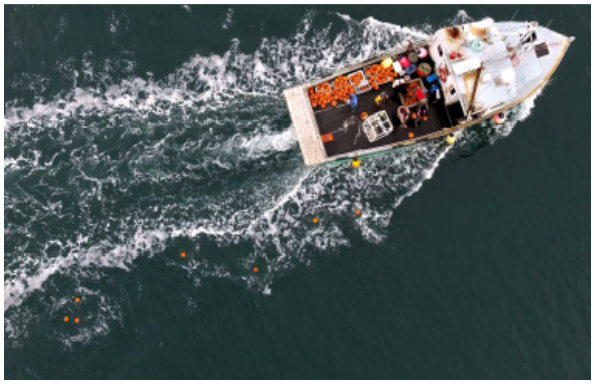
The research team will investigate a novel and in-development passive acoustic monitoring (PAM) system for use as a marine mammal detection technique. The work builds on a current research initiative between Dalhousie University and Woods Hole Oceanographic In-

stitute (WHOI) MA, USA. The Dalhousie - WHOI collaboration allows strategic access to WHOI resources (expertise, equipment, facilities) to carry out the work. The Dalhousie researchers are pioneering a system that combines autonomous underwater (Slocum) ocean gliders with the specialized WHOI- PAM system with utility to detect, classify, and report whale calls back to shore at intervals of ~2hours. One of the limitations of the 'PAM-glider' system, however, is the uncertainty in whale detection range relative to the glider. Determining detection range uncertainty is essential to effectively use the PAM system to monitor for the presence and location of whales. A system that incorporates sound-range uncertainty will provide an improved estimate of the area wherein the detected whale call most likely originated.

### *Drones and Drifters: The Great Pumpkin Race*

**Mr. Greg Trowse, Luna Ocean Consulting**

Collaborators: Dr. Alex Hay, Dalhousie University, Dr. Richard Karsten, Acadia University



The project objective is to test and develop a new low-cost approach to collecting oceanographic measurements for use in tidal preliminary site assessments. The plan is to combine one of the oldest tools in oceanography, the drifter, with one of the newest, the drone (or Unmanned Aerial Vehicles/UAV). The drone will be used to collect georeferenced images to map significant flow features. Field trials will also be conducted using 'biodegradable' drifters (pumpkins) to measure the flow field, and complemented with other GPS drifter data. The proponent will perform hydrodynamic analysis on the combined drone and drifter datasets to increase knowledge of the spatial and temporal variation of flow fields, and lead to developing a beta version of the software.

> *"Marine Renewables Canada represents businesses and organizations focused on the development of all forms of marine renewable energy in Canada. Our members who are active in tidal energy development, and the OERA in particular, have played a critical role in identifying and addressing the scientific knowledge gaps affecting the sector. OERA's key contributions have been in connecting academic and industry partners, as well as in defining future benefits with its "Tidal Energy Value Proposition".*
>
> - Elisa Obermann, Executive Director Marine Renewables Canada (MRC)

### *Turbine Wake Characterization*

**Dr. Joel Culina, CulOcean Consulting**

Collaborators: Dr. Kevin Wilcox and Ian MacLeod, Envenio, Murray Scotney, Ocean Moor Technical Services, and Tyler Boucher, FORCE

Wakes arise downstream of immersed or partially immersed obstacles including islands, seabed forms, and turbines. The spatial footprint of a turbine is not dominated by the turbine itself, rather by its wake and the associated velocity deficits and increased turbulence. Turbine wakes represent a critical constraint on turbine placement. In the context of an environment assessment, there is a clear need to properly characterize turbine wake and its near field impact on the flow regime.

The project objective is to use different tools and techniques to improve understanding of wake behaviour for use by industry in optimizing turbine placements. As a first step, the project team will deploy instrumentation to quantify and measure the wake velocity and length scales for the Open Hydro turbines in the Bay of Fundy. The Open Hydro data will be modeled to simulate real turbine wakes and compared against data

sets collected through other means including ADCP transects and the two recent FORCE FAST platform deployments. New spatial and temporal maps will be produced, including an 'eddy atlas', that collectively, can be used as wake prediction and characterization tools for turbine array planning.

### *Finite Element Analysis (FEA) to assess fish mortality from interactions with tidal turbine blades*

**Mr. Nick Fyffe, Blumara Consulting**

The project objective is to use a computer modeling technique known as finite element analysis (FEA) to simulate the impact of a tidal turbine blade on fish and to assess whether mortality of marine life can be expected in such an event. Similar FEA research has been conducted to investigate bird strikes on aircraft, as well, marine mammal-turbine strikes analysis in the UK, and fish-hydro turbine blade interactions. The here is a 'first' here in Canada, in using FEA to simulate fish-tidal turbine blade interaction and mortality.

The key research activities include running several simulations (different flow speeds and turbine operational conditions), performing a laboratory or field test using strain gauges for calibration and validation of the FEA, and assessing the simulation vs lab tested results to assess the 'likelihood of mortality' (noting that no live fish will be harmed from this work). Additionally, once the model validation step is complete, the computer model can be modified to suit Bay of Fundy fish species.

### *Real-time Particle Acceleration/Particle Velocity (PA/PV) measurement system evaluation in a tidal environment*

**Mr. John Moloney, JASCO Applied Sciences**

Collaborators: Bruce Martin, Jeff MacDonnell, et al. JASCO Applied Sciences

The research objective for this project is to design and run a field experiment to test the performance of the Particle Acceleration/Particle Velocity (PA/PV) vector sensor. The PA/PV sensor holds promise as a new environmental acoustics technology for taking noise measurements of marine life (cetaceans, crustaceans and possibly invertebrates) in a tidal environment. A PA/PV sensor will be deployed in the Minas Channel. Acoustic measurements will be taken for the PA/PV sensor together traditional hydrophone data collection for comparison and performance evaluation.

The idea is to test the PA/PV sensor's utility as a viable technology to take acoustic measurements in near real time, and in recording direction (bearing) of an acoustic noise source. The proponent acknowledges that additional field trials will be necessary to substantiate the project results. Longer term, the research goal is to provide more sensitive and accurate acoustic measurements than traditional hydrophones to support the tidal sector's environmental monitoring requirements.

### *Turbulence in Grand Passage, NS: Measures of Intermittency*

**Dr. Alex Hay, Dalhousie University**

Collaborators: Justine McMillan, Dalhousie University, Dr. Richard Karsten, Acadia University, Dean Steinke, DSA Consulting

Localized variations in current velocity intensity ("intermittency") occur at both small and large scales. Intermittency can affect turbine power production and may result in structural fatigue ultimately leading to turbine failure. To understand small scale effects, current velocity shear probe data collected in Grand Passage (2013) will be used to compute higher order statistics of the velocity shear and compare the results with theoretical predictions. One of the outcomes is to use the statistical results to validate a numerical model being developed to simulate flow in Grand Passage. At larger scales, intermittency in tidal environments can lead to (a) under-prediction of average flow velocity and (b) errors in predicting the maximum fluctuations in flow velocity. Current velocity data collected by acoustic Doppler current profilers (ADCPs) will be used to predict the probability of large "gusts" on both the ebb and flow tides. These results will have implications to calculations of turbine power production, turbine performance and the factors contributing to turbine failure in turbulent tidal environments.

### *Tidal Turbine Marine Life Interaction Study: Fish*

**Dr. Sue Molloy, Dalhousie University**

Collaborators: John Batt, Jim Eddington, Dalhousie University, Dr. Eric Bibeau, University of Manitoba, et al.

Fish interaction with tidal turbines and the ultimate physiological effect of operational turbines on different fish species remains a subject of considerable scientific and public interest. In Nova Scotia, no turbine has been deployed long enough to observe these interactions and gauge their effect. This project aims to study the effects of an operational turbine on striped bass, a species of commercial, recreational and conservation interest in the Bay of Fundy.

Research will be conducted at Dalhousie's Aquatron test tank to monitor the behavior of striped bass in the presence of an (small-scale) active turbine. The caged fish will be placed at distances from 0.5 m to 2.0 m from the turbine, which in turn will be operated at different current speeds. Fish behavior will be videotaped for later comparison. Following exposure to the turbine, cortisol levels in fish tissue will be measured to determine if, and to what degree, turbine operation causes stress in fish. The turbine operational data will be compared to data previously acquired at a test facility at Queen's University, Belfast, Ireland.

### *Fish Distribution and Presence - The Echoview Project*

**Dr. Anna Redden, Acadia Centre for Estuarine Research**

Collaborators: Dr. Brian Sanderson and Dr. Haley Viehman, Acadia Centre for Estuarine Research

This study will examine fish presence, density and vertical depth distribution over a four week 'winter period' using previously collected 'single-beam acoustic echosounder' data (2016) from the FORCE site. The project will test a new, seabed-mounted sensor technology under high flow conditions. As well, the results will help researchers understand fish use of the area, especially in the winter when water temperature are low and fish are sluggish. The results can also be used in fish encounter probability models (i.e., models that predict collisions between fish and turbines).

In addition, students and staff will be trained in acoustic data processing and analytical techniques using the Echoview software. Training and experience in the use of Echoview software is a critical Nova Scotia skills gap, since this expensive and proprietary software is a key component of hydroacoustic sensors that are proving useful in the Bay of Fundy.

*"Nova Scotia's ocean advantage presents two important marine energy opportunities: our offshore oil and gas industry, and new technology like tidal. The Offshore Energy Research Association brings government research objectives and principles together with sound academic research to help us gain a better understanding of these resources."*

- Murray Coolican, Deputy Minister of Energy, Nova Scotia Department of Energy

# Directed Research Calls

The majority of OERA's research activity is managed through a directed research call program, which ensures that projects are conducted at the highest possible standard and delivered at the most competitive cost. This process is governed by a robust set of research procedure guidelines. All research calls are authorized by the Board of Directors and overseen by panels of scientific and technical experts who guide the proposal development and assist with project selection. Projects are subject to rigorous peer review and formal contract management processes. Directed research calls enable the OERA to pursue long term research objectives, building on existing scientific findings and closing critical knowledge gaps.

Below is a summary of the Direct Research Call projects funded through the last year:

### *Real-time, targeted imaging of turbine-marine life interactions*

**Dan Wellwood, Open Seas Instrumentation**

Collaborators: Alfred White, NSCC, Dr. Haley Viehman, Acadia University, Murray Scotney, Ocean Moor Technical Services, AJ Baron, DSA, Dr. Joel Culina and Andrew Lowery, FORCE

The project is focused on engineering design and innovation to enhance tidal turbine near-field environmental monitoring capabilities. The innovation is to build in multi-perspective imaging capability, using a dynamic 'pan-tilt' mount. The adjustable mount will enable sensor imaging aimed directly at the tidal turbine. If successful, this would be considered a major breakthrough, given that to date, imaging sonars have primarily been mounted on the turbine or supporting structures and hence aimed away from the units.

The Open Seas Instrumentation (OSI) project team will work with FORCE to redesign an (existing) dynamic mount to be integrated on FORCE's FAST-2 cabled sensor platform. Project scope includes the ruggedization of FAST-2 to accommodate the dynamic mount and to better manage the harsh and turbulent flows of the Bay of Fundy. A field and demonstration test is scheduled as part of the project plans. OSI and the research team believe this innovation could become a commercial success and the 'gold' standard for multi-perspective, high resolution near-field effects environmental monitoring for high flow marine environments.

### *How does sound travel in high energy tidal environments? Effectiveness of acoustic monitoring systems and turbine audibility assessment*

**Bruce Martin, JASCO Applied Sciences**

Collaborators: Greg Trowse, Luna Ocean Consulting Ltd, Dr. David Barclay, Dalhousie University

This project plans to introduce a new approach to monitor of marine life in turbulent flow environments. Using JASCO specialized moorings, hydrophones and conductivity-temperature-depth loggers, the project team will test and measure the underwater soundscape in Petit Passage, Bay of Fundy. The goal is to improve understanding of ambient sound levels at different frequencies to better characterize how sound propagates through turbulent waters. The idea is to analyze the collected data or 'sound maps' to learn how to better detect and monitor marine mammals, as well, to determine whether marine mammals can audibly detect an operational turbine. Project results include a series of ambient monitoring data sets, audibility maps, and new turbulence modeling methods. This work will contribute to building acoustic monitoring know-how here in Nova Scotia to support the tidal energy sector.

### *Tidal Energy Finance Review*

**Dr. Shelley MacDougall, S.D. MacDougall Consulting**

A primary challenge facing tidal energy developers is the ability to find and secure financing for their tidal energy projects. The main component of the financial structure has been the Feed-in Tariff (FIT), which provides an opportunity to sell the electricity produced at predetermined prices over a long life contract. Accessing this tariff assumes the developer has been able to raise the necessary debt and equity to fund their corporate structure, acquire their equipment, secure access to insurance and performance guarantees, arrange funding for site characterization and deployment, etc.

To understand the suite of possible funding and financial support mechanisms available to project developers, OERA and Nova Scotia Department of Energy commissioned a study to examine the obstacles, limitations and existing tools to support the growth of the emerging tidal sector. The work

assessed these mechanisms, recommended a combination of approaches suitable in the Nova Scotia context, and identified institutional entities that could play a supporting financial role in tidal energy development.

### *World Energy Cities Partnership – Targeted Export Market Analysis*

**Darlene Duggan, Duggan International Marketing Services**

The World Energy Cities Partnership (WECP) comprises 19 of the world's leading energy producing cities. This year Halifax, led by Mayor Savage – who is the current sitting President of the WECP – will host the WECP 2017 Annual General Meeting. The WECP AGM will be held jointly with the Maritime Energy Association's 2017 CORE Energy Conference. As part of Nova Scotia Department of Energy's mandate to investigate economic opportunities for Nova Scotia technology developers and supply chain service providers, Nova Scotia Department of Energy commissioned OERA to manage a targeted energy market analysis before the WECP/CORE conference, then undertake a series of activities to ensure positive outcomes for Nova Scotia businesses at the conference.

The primary objective of this work is to generate information for Nova Scotia service and supply chain companies regarding potential export market opportunities and business partners in the WECP countries. A secondary objective, equally critical, is to improve B2B meeting outcomes at the WECP-Core conference, leading to enhanced export opportunities for Nova Scotia companies.

### *Sydney Basin Play Fairway Analysis (PFA)*

**Mr. Laurent Cuilhé, Beicip Franlab**

The offshore Sydney Basin Call for Bids was issued in May 2017, and targets three exploration parcels at 50-450 m water depth. In support of the Call (which closes December 14, 2017), Nova Scotia Department of Energy and OERA commissioned Beicip Franlab (following a competitive request for proposal process) to undertake the Sydney Basin Play Fairway Analysis (PFA).

The objective of the work is to identify and evaluate prospective hydrocarbon exploration plays in the offshore Sydney Basin. The ultimate goal is to build an assessment on the timing of maturity of source rock(s), prospective areas and potential plays to promote further exploration in the area. The study concludes that there is an effective petroleum system charged by good quality source rocks. The reservoir consists of sandstones sealed by thick salt deposits while the reservoir charge consists of light oil and gas. Other (younger) plays are possible, which are poorly understood due to lack of good seismic data.

### *Piston Core Geochemistry*

**Dr. Martin Fowler, Applied Petroleum Technologies**

As additional support to the 2017 Sydney Basin Call, Nova Scotia Department of Energy and OERA commissioned the RV Coriolis to complete a piston core sample collection cruise in Sydney Basin. In order to determine if hydrocarbons occur beneath the deep water, and in particular, if these hydrocarbons have a Jurassic age source rock, these samples are being subjected to a detailed geochemical assessment. This work is an extension to the 2015 and 2016 Piston Core Programs and also forms part of the Microbial Genomics project being undertaken by Dr. Casey Hubert, University of Calgary.

Confirmation of hydrocarbons from an oil-prone source rock will offer a huge encouragement to exploration in the Nova Scotia offshore. Positive identification of these hydrocarbon types in the sediments that cover bedrock would lower one of the largest perceived risks to the presence of economic accumulations of oil in this area.

### *Predictive Modeling of Sandstone Reservoir Quality in the Scotian Basin*

**Dr. Georgia Pe-Piper, Saint Mary's University**
Collaborators: Isabel Chavez, Saint Mary's University

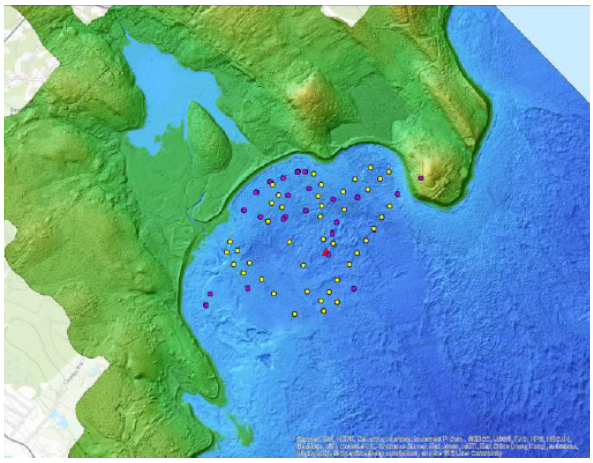
Historical sediment inputs from the continent to offshore basins form both the hydrocarbon source rocks and their reservoirs, so improved knowledge of sediment deposition contributes to offshore exploration success. This project is using existing knowledge of inferred drainage basins and paleoclimate to model multiple river inputs to the Scotian Basin. The result of this study will be improved prediction of regional reservoir quality risk in different parts of the basin. A further goal is to improve modeling protocols so that reservoir quality can be predicted in undrilled frontier basins, such as the southwestern part of the deep-water Shelburne sub-basin.

# Industry Academic Partnership Fund (IAPF)

The IAPF was developed to enable active participation between academic researchers and company based research initiatives, providing the potential for financial leverage in supporting a collaborative project. This program has become more active in the past few years as Joint Research Calls have provided researchers the opportunity to connect with academic and company partners, reducing project funding requirements to OERA and increasing the research network for Nova Scotian based academic researchers. We anticipate further growth in this program area though collaborations with entities such as France Energies Marines and Natural Resources Canada, as well as projects with the Canadian Association of Petroleum Producers (CAPP).

Below is a summary of the projects funded through the IAPF Program last year:

*Advanced Coastal Mapping to Support Hydrodynamic Modeling (LIDAR)*
**Dr. Tim Webster, Nova Scotia Community College (NSCC)**
Collaborators: East Coast Response Corp.



Following discussions with the Canadian Association of Petroleum Producers and with the support of the Department of Energy and the CNSOPB, industry participants BP and Shell are jointly funding this innovative application of LIDAR mapping and ocean modeling technologies. This is the first project to be developed under the IAPF.

The Atlantic coast exhibits of a variety of shorelines that may be vulnerable to contamination in event of an offshore oil spill. However, variable currents, changing water levels, shoals, and exposed seaside conditions together make effective spill response difficult for tidal inlets. This lack of information also presents risks to the health and safety of first responders with respect to secure access and safe navigation. NSCC's Applied Geomatics Research Group is working with the Eastern Canada Response Corporation (ECRC) to investigate how high resolution imagery, topo-bathymetric LIDAR, and hydrodynamic modeling can be used to improve spill response planning and reaction in near coastal environments.

> *"The OERA has been an effective partner for members of the CAPP in supporting critical research in areas that are beneficial to the development of the petroleum industry in this region. We will continue to work with the OERA explore opportunities for joint projects and to enhance our members access to important research initiatives."*
>
> - Jennifer Matthews, HSE Policy Analyst, Canadian Association of Petroleum Producers (CAPP)

# Student Research Travel Program

The Student Research Travel Program was developed to cultivate collaborations between Nova Scotian student researchers and international research facilities and field schools that will contribute to advancing the offshore energy sector here in Nova Scotia. The program builds on OERA's mandate to build research capacity for the province, and enables students to build national and international networks within their field. The program is open to students attending Nova Scotia universities or the Nova Scotia Community College whom are conducting research in marine renewables, petroleum geosciences or marine sound. To date, the OERA has funded over 50 students to travel across the globe to undertake research studies and bring that knowledge back to Nova Scotia.

A listing of the Student Research Travel Program awards for the past year are as follows:

*October 2016 Student Travel Program award recipients:*

**Travel to Valco in Houston, Texas**
- Chris L'Esperance, Dalhousie University

**Travel to Tritech and University of Aberdeen in Scotland**
- Haley Viehman, Acadia University

*February 2017 Student Travel Program award recipients:*

**Travel with the Petroleum Field Methods Course to Trinidad and Tobago**
- Colton Bentley, Dalhousie University
- Edmund Haynes, Dalhousie University
- Lesley Shea, Dalhousie University
- Eduardo Perez, Dalhousie University
- Camille Haddad, Dalhousie University

**Travel with the Advanced Geology Field School to Nevada/Eastern California**
- Jeffrey Arkin, Dalhousie University
- Holly Cave, Dalhousie University
- Michelle Echeverri, Dalhousie University
- Rachel Koskowich, Dalhousie University
- Jillian McKenna, Dalhousie University
- Sarah McLeod, Dalhousie University
- Gavin McNamara, Dalhousie University
- Willow (Eve) Norberg, Dalhousie University
- Hunter Smith, Dalhousie University
- Sydney Stashin, Dalhousie University
- Kara Vogler, Dalhousie University
- Jialiu Wang, Dalhousie University
- Nora Whelan, Dalhousie University
- Tristan Wolfe, Dalhousie University
- Michael Wolvin, Dalhousie University
- Yuqiu Zhao, Dalhousie University

**Travel to Bermuda Institute of Ocean Sciences**
- Alex Squires, Acadia University
- Sarah Dunn, Acadia University

> *"The Student Travel Program is an impressively organized and impactful resource for Nova Scotian students. Our field school students have benefited tremendously from not only the generous funding, but also from the reflection and thought in each of their applications and follow up reports."*
>
> - Mike Young, Senior Instructor
> Earth Sciences, Dalhousie University

*“The CNSOPB values the contribution that the OERA has made over the past few years with its offshore oil and gas geoscience work, the results of which have been used to support the CNSOPB’s annual Call for Bids for exploration licences in the Canada-Nova Scotia offshore area.”*

- Stuart Pinks, Chief Executive Officer
Canada-Nova Scotia Offshore Petroleum Board (CNSOPB)

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Financial Services

# Financial Statements

# Offshore Energy Research Association of Nova Scotia

March 31, 2017

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# Independent auditor's report

To the members of the Board of Directors of
**Offshore Energy Research Association of Nova Scotia**

We have audited the accompanying financial statements of Offshore Energy Research Association of Nova Scotia, which comprise the balance sheet as at March 31, 2017 and the statements of revenue and expenses and net assets and cash flows for the year then ended, and a summary of significant accounting policies and other explanatory information.

## Management's responsibility for the financial statements

Management is responsible for the preparation and fair presentation of these financial statements in accordance with Canadian accounting standards for not-for-profit organizations, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

## Auditor's responsibility

Our responsibility is to express an opinion on these financial statements based on our audits. We conducted our audits in accordance with Canadian generally accepted auditing standards. Those standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the Association's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Association's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained in our audits is sufficient and appropriate to provide a basis for our audit opinion.

## Opinion

In our opinion, the financial statements present fairly, in all material respects, the financial position of Offshore Energy Research Association of Nova Scotia as at March 31, 2017, and the results of its operations and its cash flows for the year then ended in accordance with Canadian accounting standards for not-for-profit organizations.

Grant Thornton LLP

Halifax, Canada
June 28, 2017

Chartered Professional Accountants
Licensed Public Accountants

# Offshore Energy Research Association of Nova Scotia
## Statements of revenue, expenses and net assets

| Year ended March 31 | 2017 | 2016 |
|---|---|---|
| Revenues | | |
| Contributions (note 3) | **$ 3,524,388** | $ 2,104,719 |
| Interest income | **31,952** | 41,992 |
| | **3,556,340** | 2,146,711 |
| Cost of research | | |
| Projects | **3,338,966** | 1,904,177 |
| Research management | **185,422** | 200,542 |
| | **3,524,388** | 2,104,719 |
| Excess of revenues before operations expenses | **31,952** | 41,992 |
| Operations expenses | | |
| Advertising and promotion | **8,701** | 620 |
| Board and committee expenses | **846** | 14,319 |
| Business development | **26,653** | 14,952 |
| Information technology | **30,438** | 20,399 |
| Insurance | **6,544** | 6,462 |
| Interest and service charges | **5,240** | 2,759 |
| Office and miscellaneous | **27,765** | 18,835 |
| Professional fees – audit, accounting and legal | **31,469** | 26,908 |
| Rent – premises | **33,120** | 33,120 |
| Research impact analysis | **17,254** | - |
| Salaries and benefits | **170,868** | 169,260 |
| | **358,898** | 307,634 |
| Excess of expenses over revenues before project recovery of operations expense | **(326,946)** | (265,642) |
| Project recovery of operations expenses | **137,044** | 108,689 |
| Excess of expenses over revenues | **$ (189,902)** | $ (156,953) |
| Net assets, beginning of year | **$ 2,756,166** | $ 2,913,119 |
| Excess of expenses over revenues | **(189,902)** | (156,953) |
| Net assets, end of year | **$ 2,566,264** | $ 2,756,166 |

See accompanying notes to the financial statements.

# Offshore Energy Research Association of Nova Scotia
# Balance sheet

| March 31 | 2017 | 2016 |
|---|---|---|
| **Assets** | | |
| Current | | |
| Cash | **$ 1,572,174** | $ 1,178,276 |
| Short term investments | **3,543,758** | 4,915,006 |
| Receivables | **207** | 5,186 |
| HST recoverable | **105,519** | - |
| Prepaids | **39,630** | 22,362 |
| | **$ 5,261,288** | $ 6,120,830 |
| **Liabilities** | | |
| Current | | |
| Payables and accruals | **$ 760,964** | $ 419,264 |
| HST payable | **-** | 6,224 |
| Deferred revenue (note 3) | **1,934,060** | 2,939,176 |
| | **2,695,024** | 3,364,664 |
| Net assets | **2,566,264** | 2,756,166 |
| | **$ 5,261,288** | $ 6,120,830 |

On behalf of the Board

_____ Director _____ Director

See accompanying notes to the financial statements.

# Offshore Energy Research Association of Nova Scotia
## Statement of cash flows

| Year ended March 31 | **2017** | 2016 |
|---|---|---|
| Increase (decrease) in cash and cash equivalents | | |
| **Operating** | | |
| Excess of expenses over revenues | **$ (189,902)** | $ (156,953) |
| Change in non-cash operating working capital | | |
| Receivables | **4,979** | 34,426 |
| HST recoverable/payable | **(111,743)** | 83,730 |
| Prepaids | **(17,268)** | (18,758) |
| Payables and accruals | **341,700** | 3,688 |
| Deferred revenue | **(1,005,116)** | 395,849 |
| Net (decrease) increase in cash and cash equivalents | **(977,350)** | 341,982 |
| Cash and cash equivalents, beginning of year | **6,093,282** | 5,751,300 |
| Cash and cash equivalents, end of year | **$ 5,115,932** | $ 6,093,282 |
| Cash and cash equivalents consist of: | | |
| Cash | **$ 1,572,174** | $ 1,178,276 |
| Short term investments | **3,543,758** | 4,915,006 |
| | **$ 5,115,932** | $ 6,093,282 |

See accompanying notes to the financial statements.

## 1. Nature of operations

Offshore Energy Research Association of Nova Scotia ("OERA" or the "Association") was incorporated under the Canadian Business Corporations Act on March 22, 2006. It serves communities, corporations and governments requiring information through research into the impacts of offshore energy activity. It is exempt under the Income Tax Act as a non-profit organization.

## 2. Summary of significant accounting policies

These financial statements have been prepared in accordance with Canadian accounting standards for not-for-profit organizations ("ASNPO") and include the following significant accounting policies:

**Cash and cash equivalents and short term investments**
Cash and cash equivalents for the purpose of the statement of cash flows include cash on hand, balances with banks, net of bank indebtedness. Short term investments consist of RBC investment savings account with cost being equal to market value.

**Foreign currency translation**
Monetary assets and liabilities are translated at rates in effect at the balance sheet date. Other assets and liabilities are translated at rates prevailing at the time of acquisition or issue. Revenues and expenses are translated at the daily exchange rate during the year. Translation gains or losses are recognized in the period in which they occur. As at March 31, 2017, cash and cash equivalents included $140,296 (2016 - $1,024,236) and payables and accruals included $Nil (2016 - $166,950) translated from Euro to Canadian dollars.

**Revenue recognition**
The Association follows the deferral method of accounting for contributions. Contributions from the Provincial Department of Energy and other government sources are allocated to projects as intended upon receipt and recognized as revenue in the year which related expenditures are incurred. Contributions receivable are recorded if the amount to be received can be reasonably estimated and collection is reasonably assured. Interest revenue is recorded on the accrual basis, once collectability is reasonably assured. Project revenue recovery of overhead is recognized once funding is received and the expenditures have been incurred.

**Deferred revenue**
Deferred revenue consists of that portion of contributions received but not yet earned.

Revenue received as grants or contributions and intended for specific project expenditures as envisioned when the grant was made are recorded as deferred revenue. Once an actual expenditure is incurred, an equal or appropriate amount of deferral is recognized as revenue in the year. Deferred revenue thereby consists of contributions received from government for specific purposes for which expenditure contracts may not yet be undertaken.

**2. Summary of significant accounting policies (continued)**

**Use of estimates**
Management reviews the carrying amounts of items in the financial statements at each balance sheet date to assess the need for revision or any possibility of impairment. Many items in the preparation of these financial statements require management's best estimate. Management determines these estimates based on assumptions that reflect the most probable set of economic conditions and planned courses of action. These estimates are reviewed periodically and adjustments are made to net income as appropriate in the year they become known.

**Allocation of expenses**
Expenditures for salaries and benefits are allocated between research projects and operations expenses on an estimated basis depending on the nature of each specific project. Included in the cost of research is $175,321 (2016 - $188,993) of allocated salaries and benefits.

**Financial instruments**
The Association considers any contract creating a financial asset, liability or equity instrument as a financial instrument, except in certain limited circumstances. The Association accounts for the following as financial instruments:

- cash and cash equivalents
- short term investments
- receivables
- payables and accruals

A financial asset or liability is recognized when the Association becomes party to contractual provisions of the instrument.

Unless otherwise noted, it is management's opinion that the Association is not exposed to significant interest, currency or credit risks arising from these financial instruments. The fair values of these financial instruments approximate their carrying value, unless otherwise noted.

*Initial measurement*
The Association's financial instruments are measured at fair value when issued or acquired. For financial instruments subsequently measured at cost or amortized cost, fair value is adjusted by the amount of the related financing fees and transaction costs. Transaction costs and financing fees relating to financial instruments that are measured subsequently at fair value are recognized in operations in the year in which they are incurred.

*Subsequent measurement*
At each reporting date, the Association measures its financial assets and liabilities at cost or amortized cost (less impairment in the case of financial assets), except for equities quoted in an active market, which must be measured at fair value. The financial instruments measured at amortized cost are cash and cash equivalents, short term investments, receivables, grants receivable and payables.

For financial assets measured at cost or amortized cost, the Association regularly assesses whether there are any indications of impairment. If there is an indication of impairment, and the Association determines that there is a significant adverse change in the expected timing or amount of future cash flows from the financial asset, it recognizes an impairment loss in the statement of operations. Any reversals of previously recognized impairment losses are recognized in operations in the year the reversal occurs.

**2. Summary of significant accounting policies (continued)**

**Project recovery of operations expenses**
Certain projects are eligible to receive a reimbursement of operations expenses at a predetermined rate. This contribution covers operations expenses and is billed directly to the project.

**3. Deferred revenue**

| | 2016 Deferred revenue | Funding | Recognized as revenue (contributions) | **2017 Deferred revenue** |
|---|---|---|---|---|
| Research projects | $ 2,939,176 | $ 2,519,272 | $ (3,524,388) | **$ 1,934,060** |

**4. Comparative figures**

The financial statements have been reclassified, where applicable, to conform to the presentation used in the current year. The changes do not affect prior year earnings.

OERA Offshore Energy Research Association

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