Blue Economy Regulatory Review:

Submission re: Marine Renewable Energy and Environmental Protection

force | Fundy Ocean Research Centre for Energy

Context

Canada’s goal, in the words of Deputy Prime Minister Chrystia Freeland, is to “become a global leader in the growing clean economy." In tidal energy, offshore wind, and clean hydrogen production, Canada has the resources, technology, labour force, and infrastructure to achieve that. Marine renewable energy (MRE) can help Canada meet its clean energy targets, contribute to our economy, and reduce reliance on imported energy.

Thanks in large part to government collaboration – through policy, funding, regulation and other supports – Canada has become a global leader in MRE research and development. With investment from the Government of Canada, the Province of Nova Scotia, and its project and technology developers, the Fundy Ocean Research Centre for Energy (FORCE) is Canada’s internationally-recognized standard bearer for MRE research and development.

The success of this effort has relied on investor confidence that, if they can develop technologies and capabilities that are viable and safe, they can eventually generate revenue to recover their investment. To date, the investment in Canada’s tidal stream energy sector has been significant: over $200 million. Investment in Canada’s offshore wind energy sector is expected to be higher still, reaching billions of dollars - all because of Canada’s enormous clean energy resource potential. In Nova Scotia alone, this includes:

- 2.5 gigawatts (GW) of tidal potential, with a strategic target of 300 megawatts (MW)
- 1,000+ GW of offshore wind energy potential, with a strategic target of 5 GW

However, due to the lack of a transparent regulatory process, all of this renewable energy and investment, including the FORCE facility, is at risk of being stranded.

On March 20, 2023, as this submission was being written, Sustainable Marine Energy Canada (SMEC) - a company that achieved an important milestone for Canada with a first-ever grid-connected floating tidal energy platform in Grand Passage, NS – advised Fisheries and Oceans Canada (DFO) that it was “withdrawing [their] application, and [would] not be continuing the development of [their] Pempa‘q instream tidal energy Project” at FORCE, citing the lack of a “pathway to deliver [their] project at FORCE, let alone one that aligns with other provincial and federal instruments.”

It would be wrong to believe that SMEC is alone in this concern.

1) Fisheries and Oceans Canada's Regulatory Regime

The Fisheries Act ("the Act") is intended to protect marine life and commercial, recreational, and Indigenous fisheries. However, a significant and growing threat to marine ecosystems is climate change, including ocean acidification and population level shifts. Generic regulatory processes do not reflect this urgent threat.

Tidal energy devices may pose some level of risk to marine life. However, this risk should be considered against the clear risk to marine life from the effects of climate change. Of note: in the last ten years of international research, there have been no observations of a marine mammal or seabird colliding with a turbine, and the limited number of interactions of fish in close proximity to a turbine have not resulted in obvious harm to fish (Copping et al, 2020)[1]. These findings are encouraging, but also reflect the physical and technical limitations of monitoring in tidal environments, and require more study. What is certain: in the last ten years, the global climate has changed significantly, with the hottest temperatures on record imposing wide ranging effects on marine ecosystems.

This combination – the potential for low environmental impacts together with significant emissions reductions – has been foundational to the Government of Canada's strong support for tidal stream energy. But at present, there are no publicly available tools, metrics, protocols or guidance for how DFO assesses risk in its MRE project permitting and authorization decisions. Nor does there appear to be any attempt to balance risk with the potential benefits of predictable MRE.

The absence of a clear assessment process for MRE leaves both regulatory officials in DFO's Fish and Fish Habitat Protection Program (FFHPP) and industry in a state of uncertainty. The result is unclear and arbitrary rulings, such as authorizing only one installation at a time, regardless of differences in the swept area of each tidal technology (an important risk metric).

If the characteristics of a device are not scientifically assessed, its uncertainties and risks cannot be managed; existing projects leave Canada and potential projects invest elsewhere. Just as important for Canada's intellectual property development, opportunities to reduce uncertainty through research go unidentified and unrealized.

If MRE is to contribute to the Blue Economy, a transparent and proportionate regulatory process that gives officials, researchers, and industry clear risk metrics is required.

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[1] Copping, A.E., and Hemery, L.G. 2020. *OES-Environmental 2020 State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World*. Report for Ocean Energy Systems (OES). In State Sci. Rep. doi:10.2172/1632878.

2) Project Specific Review Processes

FORCE seeks a path, not a pass. At the moment, no regulator or proponent can know what the regulatory pathway to commercial development looks like because it does not exist. Developing a path for all MRE will take time. FORCE suggests using the projects at its site as a pilot for developing this regulator path for three reasons: 1) FORCE's international profile; 2) the evident need to act quickly; and 3) the ten years of experience and research already in place.

As a start, the regulatory process should include an inventory of common regulatory-relevant parameters and monitoring and mitigation requirements. Common parameters include blade tip speed, blade mass, swept area, monitoring ability, marine life presence, device control, and position in the water column. In turn, each influences risk metrics and monitoring and mitigation requirements.

Monitoring will comprise a combination of standard "always-in-place" activities with additional requirements that might change iteratively as more data is collected related to the device, the instrumentation, and/or the environmental variables. Monitoring is critically supported by modelling: using biological and physical data to understand the probability that a device will encounter fish or other marine life, based on the parameters above.

FORCE believes a functional review process for specific MRE projects requires three elements to sustain and support it:

1. **A one window committee**, comprised of senior officials of key federal and provincial regulators with expert assistance as required, to integrate specific regulatory needs with broad policy objectives and to adapt processes as experience dictates.
2. **Dedicated staff** to support the one-window committee and guide MRE projects through the regulatory process.
3. **A template and submission guidelines** for proponents, outlining the process by which their project will be evaluated.

The one-window committee reporting to relevant federal Deputy Ministers (e.g., DFO, NRCAN, ISED, ECCC, TC) and provincial Deputy Ministers (NRR, DECC, DFA), supported by a chairperson (for example, as Premier Tim Houston suggested, someone like DFO Chief Scientist Emeritus Dr. Jake Rice).

An additional staff position within DFO to help navigate regulatory requirements, relevant science and science gaps, permitting and authorization decisions, and project stickhandling would have an immediate and significant impact on the sector – for government, project proponents, the scientific community, and others.

The template would be a public document, continually updated as the regulatory process responds to a growing understanding of the marine ecosystem and experience with risk, and potential and measured environmental effects.

FORCE's role

FORCE is designed to support this work with an experienced scientific team, research assets, and the capacity to generate peer-reviewed science. Its online document collection covers the breadth and depth of studies completely to date; two programs are particularly pertinent.

FORCE's environmental monitoring program (with review and contributions by national and international experts and scientists, DFO, DECC, and an independent advisory committee) currently focuses on the impacts of operational tidal stream energy devices on lobster, fish, marine mammals, and seabirds as well as the impact of device-produced sound. Since 2016, FORCE has completed approximately:

- Over 500 hours of hydroacoustic fish surveys;
- Over 5,000 'C-POD' (marine mammal monitoring) days;
- Bi-weekly shoreline observations;
- 49 observational seabird surveys;
- Four drifting marine sound surveys and additional bottom-mounted instrument sound data collection; and
- 20 days of lobster baseline surveys.

FORCE's Risk Assessment Program (RAP) is developing a science-based and transparent tool to address a key question in the permitting process: the probability that fish will encounter a device at the FORCE site. While the current predictive models are applicable to the FORCE site, they are designed to be easily modifiable and applicable to other sites with tidal energy potential. RAP is a collaborative effort between FORCE, the Ocean Tracking Network at Dalhousie University, the Confederacy of Mainland Mi'kmaq, Acadia University, Marine Renewables Canada, and local fishers.

RAP brings together the expertise and knowledge of academia, industry, government, indigenous, and community groups needed to evaluate and minimize environmental harm from tidal power devices. The collaboration also works hard to foster trust and provide a vehicle to ensure the questions and concerns of the community are properly addressed. The collaborative design of the RAP for marine renewable energy addresses concerns of stakeholders about the environmental effects of extracting clean energy from renewable sources and establishes the foundation for future environmental effects monitoring programs and best practices.

3) Key Science and Data Gaps Related to MRE Impacts/Benefits

MRE is an emerging sector. As mentioned above, to date, globally there have been no observations of a marine mammal or seabird colliding with a turbine, and the limited number of interactions of fish in close proximity to a turbine have not resulted in obvious harm (Copping et al., 2020). But the scientific community does not say MRE poses no risk to marine animals; rather, the consensus is that more device monitoring is needed to gather data to inform risk retirement or prioritization.

Instead, we are at an impasse. Small arrays are not authorized for deployment because of regulatory uncertainty, while at the same time "the lack of baseline and post-installation data continues to confound our ability to differentiate between actual and perceived risks" (Copping et al., 2020). A full evaluation of the risks of tidal stream energy devices is not possible until more are tested over a longer period with monitoring programs that document local impacts, considers far-field and cumulative effects, and adds to the growing global knowledge base.

Evidence gathered to date from laboratory and field-based studies suggest that when marine animals can detect tidal turbines, they exhibit behaviors (avoidance/evasion) to prevent being struck by turbine blades. For example, recent Scottish research found that harbour porpoise avoid turbines, especially at higher water flow rates (Gillespie et al. 2021). But there are still gaps in information related to how marine life may be able to sense, react to, and avoid an operating turbine. In the absence of this behavioral information, most progress in understanding collision risk focuses on understanding the presence of marine animals of interest in the immediate vicinity of turbines, supported by computer modeling that simulates nearfield behaviour and potential encounters – the basis of FORCE's risk assessment program (RAP).

Overall, the risks associated with single device or small array projects are anticipated to be low given the relative size and scale of devices (Copping, 2018). The three PLAT-I devices Sustainable Marine Energy Canada sought to deploy would have occupied roughly one one-thousandth (0.001 or .01%) of the cross-sectional area in the Minas Passage (Figure 1).

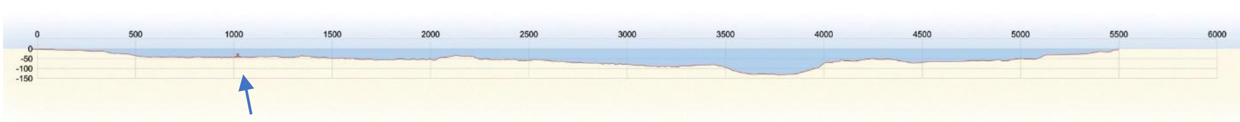

Figure 1: The scale of three Sustainable Marine Energy (SME) platforms (based on the dimensions of 18 PLAT-I turbines) in relation to the cross-sectional area of Minas Passage. The Passage reaches a width of ~ 5.4km and a depth of 130m. Alternatively: the swept area of each SME platform relative to Minas Passage is roughly equivalent to a tennis ball on a basketball court (from a bird's eye view).

The research and monitoring being conducted at the FORCE test site is part of an international effort to evaluate the possible risks tidal energy poses to marine life (Copping 2018; Copping and Hemery 2020). Presently, countries such as China, France, Italy, the Netherlands, South

Korea, the United Kingdom, and the United States are exploring tidal energy, supporting environmental monitoring and innovative R&D projects (Marine Renewables Canada, 2018).

Some estimates place MRE's potential as exceeding current human energy needs (Lewis et al. 2011; Gattuso et al. 2018). Recent research includes assessments of operational sounds on marine fauna (Schramm et al. 2017; Lossent et al. 2018; Robertson et al. 2018; Pine et al. 2019), the utility of PAM sensors for monitoring marine mammal interactions with turbines (Malinka et al. 2018) and collision risk (Joy et al. 2018b), demonstrated avoidance behavior by harbour porpoise around tidal turbines (Gillespie et al. 2021), a synthesis of known effects of marine renewable energy devices on fish (Copping et al. 2021), and the influence of tidal turbines on fish behavior (Fraser et al. 2018).

Through many partnerships and collaborations, FORCE is leading Canada's efforts to inform the global body of knowledge pertaining to environmental effects associated with tidal power projects. This includes participation in the Bay of Fundy Ecosystem Partnership[2], TC114[3], the Atlantic Canadian-based Ocean Supercluster[4], and OES-Environmental[5].

OES-Environmental is pursuing the development of new research topics for the *2024 State of the Science Report* (the global standard in MRE environmental effects research) related to: i) knowledge of environmental effects as the tidal energy industry scales up from single devices to arrays, ii) understanding the cumulative impacts of marine renewable energy with other anthropogenic effects, and iii) an ecosystem approach for understanding environmental effects, including interactions between trophic levels, between ecosystems and between ecosystem services. FORCE's science director, Dr. Daniel Hasselman, is involved in the development of all three of these topics, and is leading the effort to understand the environmental effects of 'scaling up'.

FORCE has been leading *site-level* monitoring for several years, focusing on a variety of environmental constituents: fish, marine mammals, lobsters, seabirds, and marine sound (see section 2 for additional detail). In terms of *far-field* monitoring, at present, it is unlikely that significant environmental effects beyond the FORCE site will be measurable against the backdrop of immense natural variability inherent in the Bay of Fundy (SLR Consulting 2015). Recent discussions with scientists serving on FORCE's Environmental Monitoring Advisory Committee (EMAC) suggests that the natural variability inherent to the upper Bay of Fundy

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[2] BoFEP is a 'virtual institute' interested in the well-being of the Bay of Fundy. To learn more, see www.bofep.org.

[3] TC114 is the Canadian Subcommittee created by the International Electrotechnical Commission (IEC) to prepare international standards for marine energy conversion systems. Learn more: tc114.oreg.ca.

[4] The OSC was established with a mandate to "better leverage science and technology in Canada's ocean sectors and to build a digitally-powered, knowledge-based ocean economy." Learn more: www.oceansupercluster.ca.

[5] OES Environmental was established by the International Energy Agency (IEA) Ocean Energy Systems (OES) in January 2010 to examine environmental effects of marine renewable energy development. Member nations include: Australia, China, Canada, Denmark, France, India, Ireland, Japan, Norway, Portugal, South Africa, Spain, Sweden, United Kingdom, and United States. Further information is available at https://tethys.pnnl.gov.

ecosystem far exceeds what could be measured by far-field monitoring efforts. Moreover, the scale of tidal power development would need to surpass what is possible at the FORCE tidal demonstration site to extract sufficient energy from the system to have any measurable effects at that spatial scale. In short, far-field monitoring would be futile unless tidal power development transitions from demonstration scale to commercial-scale arrays. As more devices are scheduled for deployment at the FORCE site monitoring techniques will improve and monitoring protocols revised as contemplated under the adaptive management approach that led to FORCE's establishment. These studies will be developed in consultation with EMAC, regulators, and key stakeholders.

Current research area gaps:

Defining and answering critical research questions related to risk requires many inputs. FORCE's science team and members of DFO Science and FFHPP have built a productive, ongoing relationship, and continue to have frank discussions about objectives, approaches, technology capabilities and limitations, and opportunities to trial approaches at the FORCE site. FORCE also continues to work with partners locally and internationally to address research priorities as they continue to evolve. Some current research area gaps include:

Collision risk: The sector needs a better understanding of how fish respond to the presence of operational turbines at elevated flow speeds (> 3 m/s). Fish can exhibit avoidance/evasion of turbines in low to moderate current speeds, but questions remain about whether they will have enough time to detect and respond to turbines at higher flow speeds.

Accurate population estimates for various fish species: To generate accurate estimates of encounter rates between fish and turbines, the sector needs accurate estimates of population size for the various species of interest. To that end, FORCE has been relying on DFO stock assessments, but these are relatively sparse for fish species in Minas Passage (most do not support commercial fisheries with harvest targets requiring careful management) and are not reliably accurate. This information is essential, but can be difficult and costly to obtain.

Monitoring capabilities: The sector needs better understanding of the capabilities and limitations of current off-the-shelf monitoring technologies in high flows for monitoring interactions between operational turbines and fish. FORCE is working on this: technologies hit a threshold flow rate (e.g., 4-5 m/s, beyond which their efficacy is reduced) after which modelling is needed to help fill in the gaps.

Device-centred risk; silent on climate: Perceived risk has mostly been articulated in terms of the potential negative effects of turbines on fish in the short term. Absent from risk consideration is the potential negative effects of not advancing MRE development and the consequences of climate change for fisheries (warming oceans; the effects of ocean acidification on fisheries) in the long term. A complete risk assessment would include both metrics.

4) Lessons from past assessments/implementations of MRE projects domestically; internationally

RAP: FORCE considers RAP a best practice for research study and design. RAP, which began in 2020, was created to develop a scientifically valid assessment tool to estimate the probability that fish will encounter a tidal energy device at the FORCE site. The tool combines two things: 1) a live flow atlas that describes how water moves through the Minas Passage; and 2) a fish atlas that describes fish presence and distribution in Minas Passage by tracking acoustically tagged fish. Combining these inputs provides a model that describes the likelihood that a particular fish species may be in the same location as a tidal device in Minas Passage, Bay of Fundy. In other words, an encounter rate model, or ERM: a standard tool in environmental permitting and monitoring. The early results are both innovative and promising, but perhaps more important is the process. RAP is a collaborative effort between FORCE, the Ocean Tracking Network at Dalhousie University, the Mi'kmaw Conservation Group, Confederacy of Mainland Mi'kmaq, Acadia University, Marine Renewables Canada, and local fishers. RAP includes partners with diverse perspectives on tidal energy and brings them together, and compensates all partners for their participation. It welcomes knowledge, expertise and perspectives from academia, industry, government, indigenous, and community groups. It builds a tool to ensure diverse questions and concerns are heard and addressed – critical to building a transparent regulatory approach to MRE.

SDM: The Survey-Deploy-Monitor approach to tidal energy development adopted by Marine Scotland Science is a sound, adaptive management-based approach to facilitating growth of the marine energy sector while still taking into consideration the core elements of the precautionary approach. Canada's current challenge is a paradox: we can't understand the effects of tidal turbines on fish without permitting the deployment of these devices. This *in situ* data is vital to further refining and clarifying risk.

Transferability of methodologies: DFO is understandably reluctant to take the results of monitoring in other jurisdictions as an indication of how fish in Minas Passage will respond. To help credibly integrate the global body of knowledge on MRE, the sector needs to replicate study designs from other jurisdictions in Minas Passage that have demonstrated environmental effects to show consistency. However, this work is also contingent on the deployment of energy devices, so studies can be replicated.

Academic capacity: As mentioned above, the challenge to building a clear regulatory template, to measuring risk consistently, and to authorizing a project, comes in part from a lack of knowledge related to MRE risks. The UK has established a pipeline of skills development through graduate student programs (MSc, PhD) and post-doctoral fellowships that are tailored to facilitating the MRE sector (i.e., Environmental Research Institute at the University of Highlands and Islands). These programs serve as the training ground for science personnel that generate peer-reviewed research that ultimately shapes our understanding of environmental effects of MRE devices. University research still remains the standard for credible risk retirement. This academic pipeline needs replication in Canada. To that end, FORCE advocates for the establishment of a joint-publicly funded (i.e., NRCan, ECCC, NRR) and permanent Research Chair in Marine Renewable Energy Development embedded at Dalhousie University where they can tap into the strengths already established there (i.e., Marine Biology, Oceanography, Marine Engineering, Environmental Law, Marine Affairs Program, Ocean Tracking Network, Ocean Frontiers Institute, to name but a few).


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