case study

Ensuring Success of Marine Operations in Tidal Energy

Installation Analysis of OpenHydro's turbine using ProteusDS

Client:	OpenHydro - Cape Sharp Tidal Project
Location:	Minas Passage, Bay of Fundy, Nova Scotia
Capacity:	4MW and 1,000 customers initially, growing to 300MW and 75,000 customers in the 2020's
Scope:	Simulation and analysis

Dynamic Systems Analysis Ltd.

For nearly 10 years, DSA has been supporting the marine renewable energy industry through the development of custom software solutions for the most challenging dynamic analysis problems. DSA's ProteusDS and ShipMo3D simulation software tests virtual prototypes of vessels and equipment operating in ocean conditions.

Virtual prototypes enable the tidal energy industry to answer questions related to engineering design, planning, training, operations, and safety. Understanding the dynamic effects of ocean current, wind, and waves can significantly reduce the risk and uncertainty of vessel motions and loads on equipment in an ocean environment resulting in safer designs and lower risk and project cost.

OpenHydro

Cape Sharp Tidal is a joint venture between OpenHydro and Emera with the aim to deploy a grid connected 4MW tidal array in the Minas Passage, located in the Bay of Fundy, Nova Scotia. This project has the potential to be one of the world's first interconnected multi-megawatt tidal arrays, providing energy to more than 1,000 customers initially.

OpenHydro is a DCNS company that specializes in the design, manufacturing, and installation of marine turbines generating renewable energy from tidal streams. A world leader with a vision to deploy tidal turbine farms throughout the world's oceans to silently and invisibly generate electricity with minimal impact on the environment.

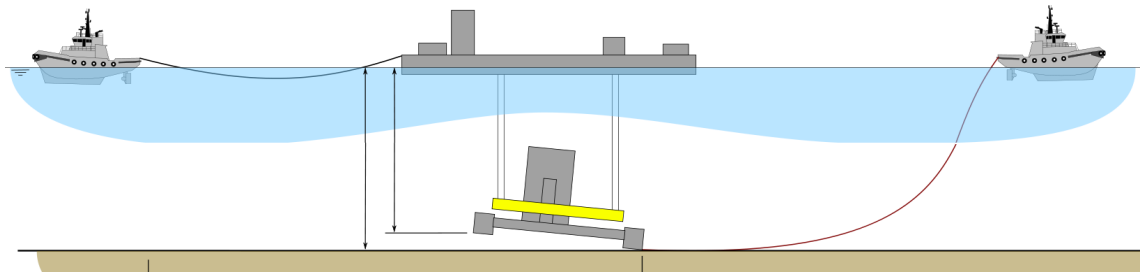
Background

The Minas Passage has some of the strongest tides in the world. Flow speeds range from zero to 11 knots in the 5 km wide, 40m deep channel. Due to these unique environmental conditions and this huge potential resource, Nova Scotia can claim what the industry refers to as "The Fundy Standard". If a tidal energy device can successfully work in these extreme conditions, it can work anywhere in the world.

Perhaps the biggest technical barrier the tidal industry faces is simply installing and maintaining turbines and cables in challenging sites like the Minas Passage. Traditionally, sea trials and experience would have solely guided marine operations, however there are many unknowns and little experience in working in extreme tidal environments. A combination of marine experience and advanced engineering analysis with tools like ProteusDS are necessary to ensure the successful installation and maintenance of equipment to safeguard the economic viability of the tidal energy project.

OpenHydro's Minas Passage installation challenges

- Manoeuver the *Scotia Tide* deployment barge into position with tugs while maintaining control of export cable.
- Lower OpenHydro's 21m (69 foot), 1100T submerged weight open-centre tidal turbine to the sea floor.
- Align turbine into optimal orientation relative to flow at the sea floor.



mock-up of tug configuration

Scope of work

- Develop a numerical model capable of simulating the seakeeping behaviour of the *Scotia Tide* deployment barge with a tidal turbine in place to be lowered.
- Simulate the tugs, tow lines, turbine lifting lines and associated installation operations in the ProteusDS simulation software.
- Verify the power requirements of the tugs.
- Simulate the towing and lowering of the 16m OpenHydro tidal turbine in the Minas Passage.
- Determine optimal tow configuration for turbine and Scotian Tide deployment barge (i.e. positioning of tugs, deployment barge, tow hawser lengths)
- Simulate and assess turbine lowering.
- Conducted simulations of maneuvering and aligning the turbine on the sea floor.
- Provide recommendations and feedback on operations to OpenHydro and Atlantic Towing based on the dynamic analysis that will minimize installation risks.

Outcomes

- Reduced operational risk of ferrying OpenHydro's turbine to deployment site by identifying optimal tow arrangement.
- Identified tow arrangements which were less stable and provided less overall seakeeping control of the *Scotia Tide.*
- Verified that the hydrodynamic and tow loads on the critical electrical export cable during lowering of the turbine.
- Identified the deflection of the OpenHydro turbine and loading on the winch and lifting lines under the presence of the tidal flow through the lowering simulations.
- Identified the optimal tug operations/configurations to provide ideal control and final alignment of the turbine on the seafloor.
- Provided in-depth 3D visualizations of all critical simulations and in-depth final report that can be used to inform OpenHydro operations in Minas Passage and in other projects across the globe with similar environmental conditions.

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