

## ENVIRONMENTAL EFFECTS METADATA SURVEY FORM

Name of person updating the form

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Project name: Fundy Ocean Research Center for Energy (FORCE) test site

Planned  In Operation  Completed

Project description:

*Project Developer:* FORCE

*Technology Developer:* FORCE

*Technology type:* In-stream tidal turbines of several technologies

*Resource (wave, tidal):* Tidal

*Project scale (test site, prototype, array, commercial):* Test site with four berths

*Installed capacity (MW):* Alstom Beluga 9 turbine is rated 1MW, Atlantis is also 1 MW, the OpenHydro system is rated 1.1 MW, and the Marine Current Turbines unit is rated at 1.2 MW

*Project Website:* <http://cdm.unfccc.int/>

*Launch Date:* November 2010

*Additional Description:* Each of the three turbines that are going to be installed is designed to use the flow of the passing water to turn an impellor, just like a windmill. Each turbine is different in how it manages this but, in the end, each uses the rotation of its turbine to turn an electrical generator.

Location:

*Ocean/Water body:* Minas Passage, Bay of Fundy

*Closest city:* Black Rock

*Country:* Canada

*Depth:* Water depths up to 45 meters at low tide.

*Coordinates (please use Mercator):* 45.36976°, -64.40254°

Process status: FORCE is scheduled to install four subsea transmission cables to connect the test turbines to the electrical grid in the summer. Technologies from several companies or consortiums are going to be installed: Alstom / Clean Current; Atlantis Resources Corporation / Lockheed Martin / Irving Shipbuilding; Open Hydro / Nova Scotia Power. Nova Scotia Power tested a 1 MW OpenHydro turbine at this site between November 2009 and December 2010 and additional technologies will be installed in future years. The submarine cable is fabricated and ready for installation in advance of the next turbine deployment. The land-based facility is now complete and open to the public.

Licensing information (brief description): New developers wishing to test their technology at FORCE will not be required to make an Environmental Assessment application to the Province of Nova Scotia or the Government of Canada, as long as the new device:

- Occupies one of the four existing berths at FORCE;
- Replaces one of the four turbines tested;
- Is not predicted to have significantly different environmental impacts from the previous technologies tested.

The complete Environmental Assessment Registration Document for FORCE (Registered on June 17, 2009 under the Nova Scotia Environment Act), including the Terms and Conditions of Approval can be viewed at: [www.gov.ns.ca/nse/ea](http://www.gov.ns.ca/nse/ea). New developers are responsible for obtaining the following Federal authorizations and/or permits prior to device deployment: Fisheries Act (administered by Fisheries and Oceans Canada); Navigable Waters Protection Act (administered by Transport Canada); Canadian Environmental Protection Act (administered by Environment Canada).

Key Environmental issues: Physical environment, benthic habitat, fish movement, marine mammals, sea birds and lobster presence in the Minas Passage.

Environmental webpage: <http://fundyforce.ca/monitoring-and-research/enviromental-assesment/>

<b>Baseline studies and project effects studies: Fundy Ocean Research Center for Energy</b>				
<b>General description</b>	The FORCE project was assessed under a joint federal – provincial Environmental Assessment (EA) review process, which considered multiple subsea turbine generators, subsea cables connecting the turbines to land-based infrastructure, an onshore transformer substation, and power lines connecting to the local power distribution system.			
Receptor	Study description including question and/or objective	Design and methods (brief description)	Results (brief description)	Status (planned, underway, completed, with dates)
Physical environment	Bathymetry and geology and sediment transport and suspended sediments.	Multibeam sonar system survey.	The region is flat gravel covered glaciomarine sediment. A large scoured region of seabed is shown that contains many singular symmetric sand waves within the depression. This is an area of active erosion but the currents are likely not strong enough to transport the	Completed

			sand sized material out of the depression. Large quantities of silt and clay are eroded from this feature and are likely transported as suspended sediments.	
	Ice and seismic conditions.	Background on earthquakes in eastern Canada. Calculation of seismic hazard. Analysis of faulting.	Minas Passage is considered to have a low earthquake risk. Historically, earthquakes in the region have been infrequent and of small magnitude.	Completed
	Currents.	Vessel mounted ADCP. Moored ADCP. Bottom current, water level and bottom temperature data analysis.	Currents characterization: current speed and direction during Spring and Neap tides.	Completed
	Physical oceanography	Oceanographic measurements included possible sites for tidal device installations and cable routing, were made in August and September 2008 and February and March 2009, as part of a survey which included a seabed video and photographic survey; water column temperature, salinity and turbidity profiling; water column sampling for suspended solids; background noise measurements; and retrieval and deployment of current meter moorings.	The water column was well-mixed vertically on all occasions, showing negligible difference between surface and bottom.	Completed
Benthos	Seabed biological	Seabed sampling and video and still	Seabed communities at the proposed site tidal power	Completed

	communities.	photographic survey to gather information on seabed characteristics and seabed biological communities.	demonstration project in Minas Passage show a moderate diversity of organisms visible and identifiable in video and photographs. The uniqueness of the current regime at the site (i.e. the highest tides) may result in unique features, such as the biolayer fauna and the possibility of occurrence of several species which are unique from a conservation perspective.	
Fish and Fisheries	Commercial fisheries.	A review of information on the commercial and recreational fisheries included interviews and personal contacts with fisheries officers, individual fishers, and representatives of key fisheries sectors, as well as a review of published and unpublished information on fisheries in the Inner Bay of Fundy.	No areas are precluded for development as tidal power sites, due to the broad geographic distribution of fisheries resources and fisheries, and the small footprint of the demonstration facility. The lobster fishery in Minas Passage is the most important commercial fishery with which there will be potential interactions with the tidal power demonstration project. Liaison with fishers will be required, both for demonstration and commercial scale developments of tidal power facilities in the area. The presence of herring and ground fish fisheries in the Southern Minas Channel, and a lobster fishery throughout the area, including Minas Passage, also make some areas such as the northern Minas Channel and deeper parts of Minas Passage more preferable in terms of fisheries interactions for possible locations for demonstration and commercial scale tidal power projects.	Completed
Large Vertebrates	Marine mammals.	Routine watches for seabirds and marine mammals during the course of a cruise.	Minas Passage supports low densities of seabirds and no marine mammals were observed.	Completed
Birds	Seabirds.			Completed
Marine Transportation	To investigate and describe commercial	Desk based study.	The largest vessels sailing the Minas Channel on a regular basis are gypsum bulk carriers with a	Completed

	shipping activities in the Minas Channel area to assist the preliminary site selection survey by identifying “no go” areas for potential Demonstration Facility sites.		maximum (fully loaded) of 10 m. The number of gypsum vessel movements is probably >200 per year. The gypsum vessels sail through the passage following the deepest portion near the centre, closer to the Cape Split side of the Minas Channel. A maximum clearance of 15 m from low tide level to the highest point of the device / facility would be adequate, with a comfortable safety factor, if the Demonstration Facility site is in or close to the gypsum vessel traffic patterns. If the Demonstration Facility is closer to the Cape Sharp side away from the gypsum vessel traffic pattern, this clearance could possibly be reduced, since other vessels operating in the area have drafts in the 2-3 m range.	
Archaeological Assessment	N/A	Maritime Archaeological Resource Inventory. Historical Background.	Whenever possible, effort should be taken to avoid disturbance of the ravine and the cellar sites. No active mitigation plan is recommended for these features. Nevertheless, should adverse impact to these resources be unavoidable, further investigation is necessary. Given the presence of First Nations artifacts in the vicinity, it is recommended that archaeologists be present to monitor all geotechnical testing and the excavation of the trench from the beach to the building site.	Completed
<b>Reports or Papers</b>	Appendices of the EIA are available in the environmental website of the project			
<b>Research Projects</b>	N/A			

### Monitoring and adaptive management: Fundy Ocean Research Center for Energy

**General description** Prior to construction or device installation, an Environmental Management Plan (EMP) was submitted for review and approval (DFO). The EMP should address construction, installation, operation, and decommissioning phases of the Undertaking. As part of the

project EMP, an environmental effects monitoring program (EEMP) was developed. The EEMP was started in September 2009 prior to the deployment of the turbine and has been operating since then. The summary below was taken from the 2011 report.

<b>Receptor</b>	<b>Monitoring program description including question and/or objective</b>	<b>Design and methods (brief description)</b>	<b>Results (brief description)</b>	<b>Status (planned, underway, completed, with dates)</b>
Lobsters	Lobster Catch Monitoring.	This study was based on measuring lobster catch ability within test and control areas using commercial lobster traps, in an attempt to assess potential changes in fishing success as result of the deployment and operation of a tidal turbine. Three surveys were conducted, two in the Fall of 2009 (before and after turbine deployment) and one in the Spring of 2010.	Lobster fishing is essentially the only commercial fishing activity which occurs in the vicinity of the tidal energy demonstration area. The key results are summarized for the 2009 and 2010 surveys; these include independent statistical results review and recommendations for future surveys.	Ongoing
Marine Birds	Seabirds survey.	Shore-based day long observations of seabirds and marine mammals (May 1, 12 and 27; June 12; Oct 23; Nov 13 and 22, 2010) in the Minas Passage area near the tidal energy project site, as well as two vessel –based surveys carried out in July and August 2010.	The report provides a summary and interpretation of the seabird and mammals observations and presents recommendations for future surveys.	Ongoing
Marine Mammals	Marine mammals survey.			Ongoing
	Detection of Marine Mammals and Effects Monitoring at the NSPI (OpenHydro) Turbine Site in the Minas Passage during 2010.	Three month long passive acoustic marine mammal monitoring field study (Aug 10 to Nov 23, 2010) while the NSPI (OpenHydro) tidal turbine was deployed in the Minas Passage. Three C-POD hydrophones (autonomous cetacean echolocation click detectors) were deployed in close proximity (~150 m) east and west of the	The survey successfully detected harbor porpoises during the survey, with no dolphin species detected, and will continued to be used in future studies. Recommendations for deployment improvements, data loss prevention and study designs are	Ongoing

		turbine, while a third was positioned a control site ~700 m west of the turbine site.	made.	
Fish	Occurrence and Migration of Fishes and their potential for tidal turbine interaction.	Detailed review based on the available published and unpublished literature.	The fishes are listed in two ways; a taxonomic listing and, a listing based on their potential risk of interaction with the proposed turbines.	Completed
	Determination of fish movements in the vicinity of the FORCE Site.	Acoustic Tracking of Fish.	This application of the technology was successful and will continue to be employed and expanded in 2011 to gather further information on fish movements.	Ongoing
Physical Oceanography	Oceanographic Measurements from Ships to Opportunity. Measurements were made in July, August, and October 2010 and January 2011.	A standard Secchi disk deployment was used to measure transparency; surface water samples were taken for laboratory measurement of suspended sediments; and surface temperature was measured to an accuracy of 0.1° C using a thermometer calibrated to a U.S. National Institute of Standards (NIST) standard.	Information on water transparency, suspended sediment, and water temperature.	Completed
Benthic Environment	Environmental Monitoring of Seabed Sediment Stability, Transport and Benthic Habitat at the Reference Site and the Vicinity of the deployment site. To determine conditions on the bottom after the recovery of the turbine assembly. To determine both	A side-scan sonar and towed video camera survey was conducted at the Reference Site and at the location of the NSPI/OH test deployment site. Sonograms and side-scan sonar mosaics were interpreted, compared and contrasted with previously collected multi-beam bathymetry and derived backscatter and slope imagery.	The analysis showed no detectable seabed change at the Reference Site since the original data was collected over 5 years ago.	Completed

	natural change and possible effects of the turbine placement, operation, and removal over a one year time frame.			
<b>Reports or Papers</b>	Reports of the monitoring studies are available in the environmental webpage of the project			
<b>Research Projects</b>	Reports of the research studies are available in the environmental webpage of the project: <a href="http://fundyforce.ca/monitoring-and-research/monitoring/">http://fundyforce.ca/monitoring-and-research/monitoring/</a> and <a href="http://fundyforce.ca/monitoring-and-research/research/">http://fundyforce.ca/monitoring-and-research/research/</a>			