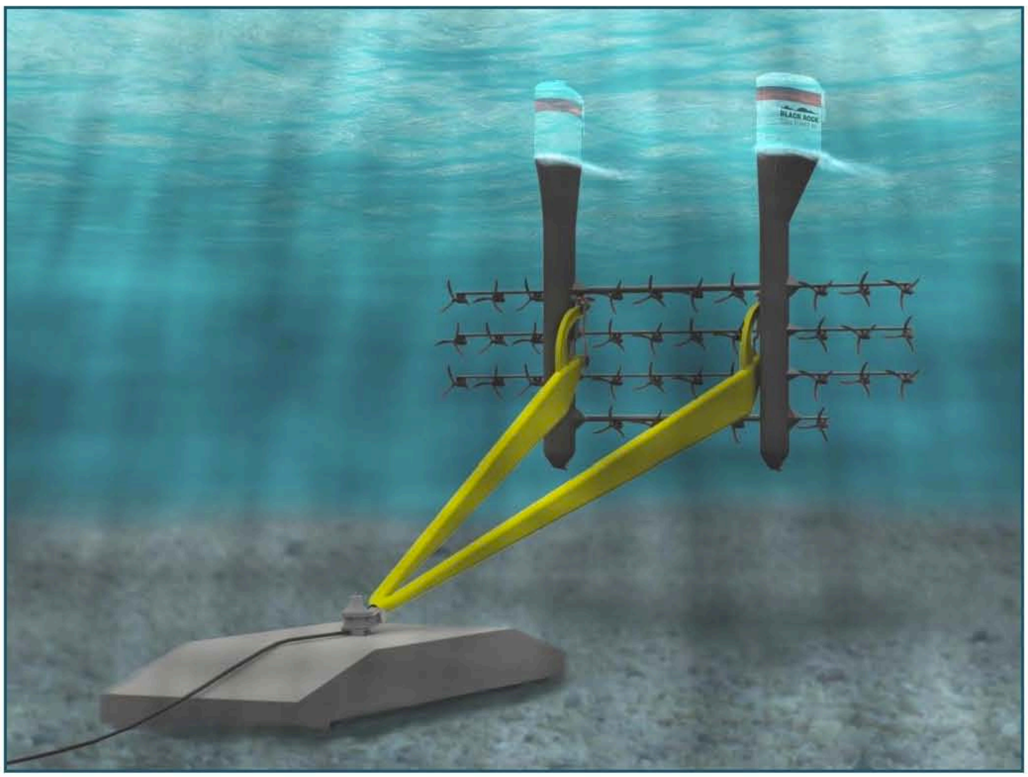
BLACK ROCK
TIDAL POWER INC.

IN-STREAM TIDAL ENERGY DEMONSTRATION PROJECT BERTH D (Fundy Ocean Research Centre for Energy - FORCE)

RFP #60144758 (Excerpt)



TRITON S36

BLACK ROCK TIDAL POWER INC.
1111 Bedford Highway
Halifax, Nova Scotia
B4A 1B9 CANADA
info@blackrocktidalpower.com
+1-902-233-3265

2.0 THE PROJECT

2.1 Technology to be Deployed

2.1.1 Introduction

Most of the existing tidal current energy systems that have been deployed to date are single turbines designed to rest or be installed on the seabed. The single turbine approach leads to enormous machines with average drive train masses of 150 tonnes per MW installed power. Beside the high capital expenses for these huge machines the operating expenses are significantly driven by the necessity to transport the devices to a maintenance base, requiring heavy gear and suitable onshore infrastructure.

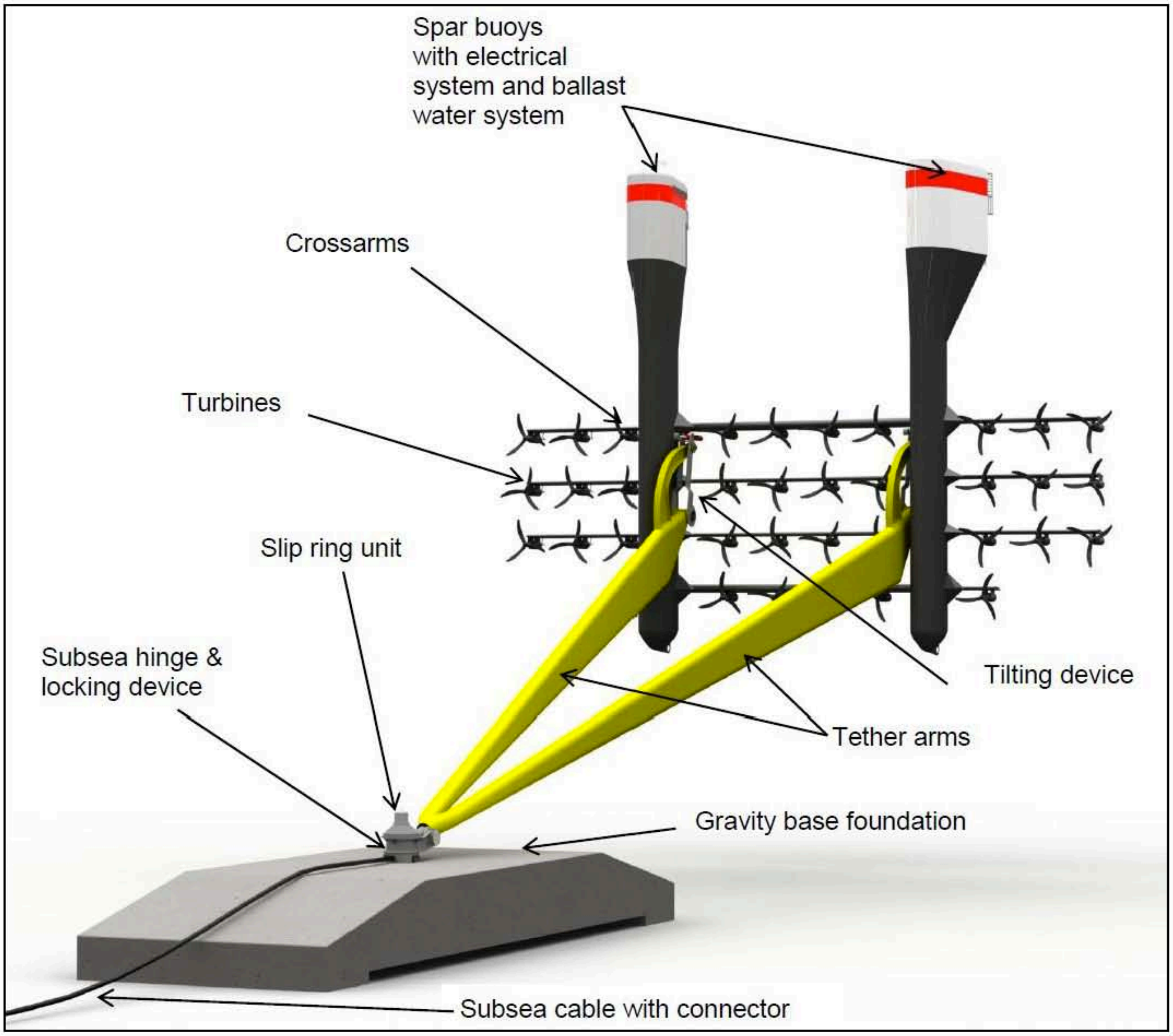


Figure 33 TRITON S36 - device overview in operating position

BLACK ROCK TIDAL POWER is directly addressing the identified cost drivers with the unique approach to combine the innovative TRITON platform developed by TidalStream, which is semi-submerged, floating and freely rotates to the flow, with inexpensive small and robust tidal turbines (STG) made by SCHOTTEL. **Both, TSL and SCHOTTEL will provide their related IP to this project. A letter declaring Schotttel's ownership of the STG design is found in Appendix D.**

The TRITON S36 platform supports 36 horizontal axis turbines type SCHOTTEL STG and the related electrical power conversion equipment for autonomous production of electrical power at sea. A dimensional drawing of the TRITON S36 is attached to Appendix B, with a large-format version found in Appendix F.

Two spar buoys and four crossarms are assembled to a semi-submerged structure Figure **33**. The horizontal axis tidal turbines are attached along the crossarms of this structure. The floating structure is tethered to a gravity-based foundation and has rigid tether arms in a "V" configuration that join at a subsea hinge that allows yawing, pitching and rolling around a pin. The turbines will be aligned to the flow direction by passively swivelling (moving with the tide) around the pin. Further the floating structure is designed either to float on its spar buoys like a catamaran or to be ballasted into the semi-submerged position where only the top section of the spar buoys is piercing the water surface. Position keeping of the whole assembly is achieved by the frictional connection between the gravity base foundation and seabed only.

The electrical power produced by the individual turbines is collected and conditioned in the electrical room located in one spar buoy. Grid compliant electric energy is transferred by cable from the floating structure to a slip ring unit located at the subsea hinge and further to a dry mate subsea connector, which connects the device to the grid via a subsea cable. Additional conditioning of the electrical energy on shore is not required.

The whole structure will be assembled and floated in a sheltered area (e.g. dry-dock) and then towed out to the installation location. After lowering down the gravity-based foundation the sea cable is connected. Further the floating structure will be ballasted into the operating position. Decommissioning of the device will happen in the reverse order.

For maintenance of the electric system access into the spar buoys is available even in the operating position. For maintenance work on the turbines or the floating structure (e.g. de-fouling or turbine replacement) the structure will be de-ballasted into the maintenance position where the systems can also be accessed.

De-Risk step by step

Sheltered site tests will be performed with the entire deployment team and the full assembly before deployment. OpenHydro completed tests with Atlantic Towing in the Bedford basin before deployment [5] and it is anticipated that BRTP will build on that experience.

The project will demonstrate SCHOTTEL's and TidalStream's technologies by using a low risk step-by-step approach (Figure 34):

- Stage 1: To keep the risk low, the first TRITON platform that is designed for an overall capacity of 2.5 MW will be equipped with a smaller number of turbines (e.g. 16 units with approx. 1.1 MW rated power).
- Stage 2: After a certain time (approx. one year of operation), the remaining turbines will be mounted so that the platform features an overall capacity of 2.5 MW.
- Stage 3: After approx. two further years a second platform at 2.5 MW rated power shall be installed to use the full capacity of the 5 MW berth.

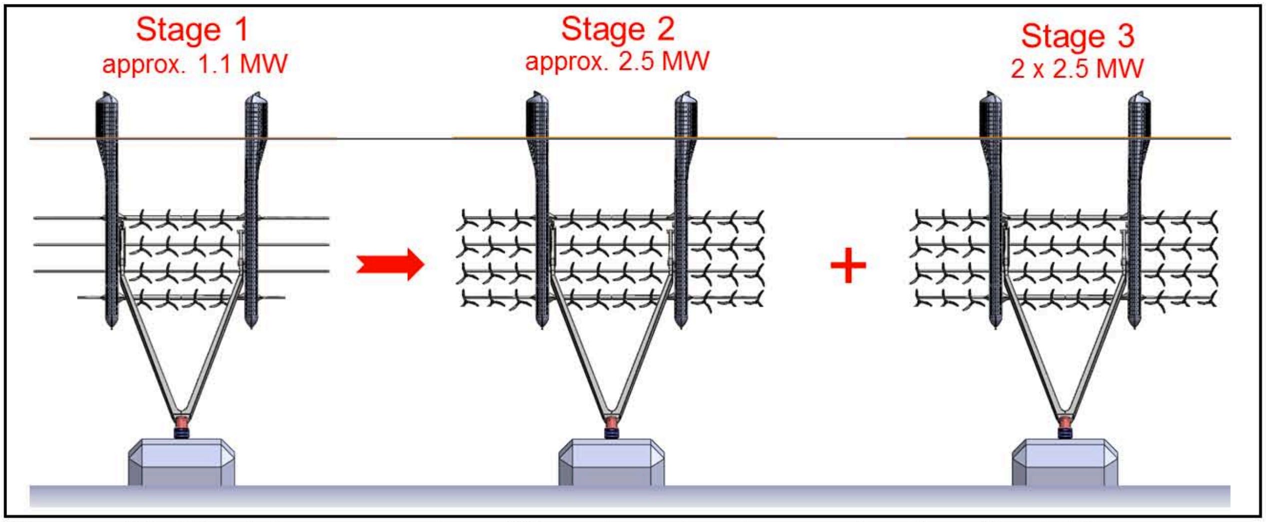


Figure 34 De-risk approach - Stepwise development of a 2 platform array (schematically)

Table 11 - Technical Parameters

Cut in speed:	<1 m/s
Rated speed:	3.95 m/s
Ultimate design speed:	7.85 m/s
Amount of turbines:	36 pc.
Turbine diameter:	3.0 m
Rated power output:	2500kW (electrical active power, Grid AC)
Output Voltage:	13.8kV (Grid Voltage AC)
Amount Phases:	3 (Grid site)
Platform Voltage:	400-500V AC, 208V/120V AC
Network configuration platform:	IT-Net or TN-Net with earthed star-point
Power quality standard:	UL 1741, IEEE 929, CSA-C22.2 No.107.1-01
Power factor range	0.95 Lag to 0.95 Lead at rated output
Frequency	60Hz

2.1.2 Turbine

The SCHOTTEL TIDAL GENERATOR STG is the result of thorough research in tidal energy with the **focus on low investment and maintenance costs**.

The three bladed horizontal axis turbine features passive adaptive blades to reduce the thrust force without a complex active pitch drive. The straightforward and reliable drivetrain is cooled passively by the ambient water and consists proven components and is easy to maintain.

A very high power-to-weight ratio and thus a good power-to-cost ratio results from the relatively small size of the turbine. The output of the energy collector system can be scaled up with the parallel arrangement of numerous turbines in one support structure. Further advantages of the downsizing and modular arrangement are

- low requirements for facilities and equipment for servicing
- a simplified logistic
- cost reduction due to serial effects.

Figure 35 - SCHOTTEL Tidal Generator (STG)

Table 12 - Main Parameters

This section contains business sensitive information and/or intellectual property. For questions or information, please contact the document author.