

Mechanical seals for marine current turbines



The development of renewable energy sources is being driven forward worldwide. Next to wind and solar energy, geothermal energy and hydroelectric power, marine energy is increasingly gaining importance. This entails generating energy from marine currents with compact turbine systems.

Public institutions and the industry have been investing heavily in this pioneering sector for several years. In the meantime, several systems are being tested or are already producing power.

Based on the extensive experience in the area of mechanical seals for marine applications, EagleBurgmann was able to supply reliable sealing solutions for the innovative technical concepts of different manufacturers.

New technology with great potential

Tides are a predictable, consistent and inexhaustible source of energy. The potential energy of the water can be converted into electricity with great efficiency. With its 80 % it is much higher than the other energy sources.

Triggered by low tide and high tide, currents have already been used in the past in locations with a large tidal range. Examples are the tidal power station Rance in France, which has been supplying power for north France since 1967, and the Sihwa-ho station in Korea, which is the largest of its kind with an output of 254 MW. These



Wind parks under water: Producing energy from marine current turbines has a strong future.

stationary power stations are characterized by large inlet structures.

However, the new technology relies on a compact and partially modular design and/or mobile and visually unobtrusive systems which are universally deployable yet do not greatly impact the marine habitat with its flora and fauna. Among other things, it is implemented by using new types of current turbines that are comparable to a wind turbine under water. They can also produce power during slow currents and a low tidal range. The generated power is conducted over cable to the mainland.

The potential of energy to be produced largely depends on the location. The faster the tides flow, the higher the yield, and it may not be too far away from the consumers. Preferred locations are found, among others, in Nova Scotia Canada, Southeast Asia, North Australia and around the British Isles. According to a study, approx. 20 % of Great Britain's requirements could be covered with energy from marine current power stations.

Applied systems and trial

Well-known international companies have implemented innovative concepts, machines and installations in recent years. New technical concepts, installations and turbines were and are being tried and tested, among others, in the waters off the shores of the Scottish Orkney Islands. The EMEC (European Marine Energy Centre) provides the required infrastructure for installation and operation as well as measurement data evaluation and analysis to the companies there.

In the technically well-engineered area of current turbines, three categories of systems have proven to be feasible:

- Individual turbines lowered to the seabed
- Platforms with several individual turbines
- Turbines anchored to the seabed and floating in the current (e.g. Kites).

For the current turbines installed in these applications, EagleBurgmann was able to provide the customers with robust and reliable sealing technology already during the development phase. But different types of EagleBurgmann mechanical seals were also delivered to the other (pilot) projects of e.g. GE (Alstom, RollsRoyce) and SEW Eurodrive.

Sealing technology requirements

The turbine shafts are sealed at the passage through the housing to the propeller as the seawater may not penetrate the bearing. Seawater-resistant materials and tolerance of solids in water are therefore a requirement. Also, the seals are often subjected to higher pressures since the installations are lowered to depths of over 30 m (100 ft).

The low speeds of the current turbines present a challenge to the mechanical seals, because contrary to e.g. the sealing of high-speed machines such as pumps, there is practically no lifting of the sealing surfaces which can cause a lack of lubrication at the sliding faces. In addition, the regularly occurring reverse current flow during operation and its associated change of rotational direction of the turbine shaft are also a great load for the seals.

The recovery and servicing of marine current turbines is complicated and expensive. As a result, long operating periods and an MTBS (Mean Time Between Service) of over 5 years are required. The seal system must be of an accordingly robust, non-wearing and reliable design.

Since there are different concepts and installation parameters of current turbines depending on the manufacturers, customer-specific requirements must be met with e.g. constructive adaptations.

EagleBurgmann – the partner for sealing technology

EagleBurgmann has decades' worth of experience in mechanical seals for marine applications (e.g. for different types of thruster drives for ships). Together with robust, versatily deployable and proven products, this know-how enabled us to supply the respectively correct sealing solution for new applications in this innovative and revolutionary energy sector.

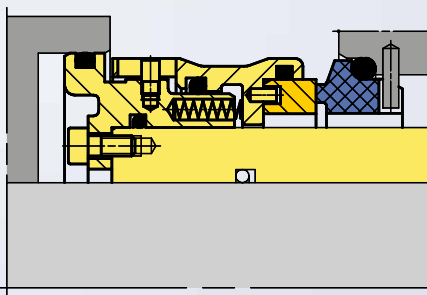
We are introducing two selected examples from practice and the successfully installed sealing solution here. We would be pleased to provide further reference upon request.



Kite surfing in tidal current: The seven ton power station proves to be very efficient in practice.

Project "Deep Green"

The Minesto Kite System is lowered to the seabed at a depth of 120 m (400 ft) and can already generate power at low current speeds of around 1.2 ... 2.5 m/s (4 ... 8 ft/s). The kite-shaped device equipped with a turbine is buoyed by the tidal current which moves it in a figure-8 course, helping it reach speeds of comparatively ten times higher than the current. Areas where the Kite System is currently in operation are Holyhead Deep, Great Britain, and Strangford Lough in North Ireland. The current turbines were supplied by Schottel Hydro Germany, and the operator is the Swedish company Minesto. The output of an individual system is at 0.5 MW.



Utilized mechanical seals

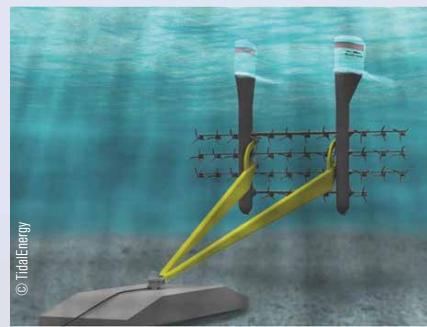
EagleBurgmann marine mechanical seal type 19.9700.170.01

Features

- Single seal in semi-cartridge version
- Bi-directional
- Hard/soft face material combination
- Seawater protected multiple springs

Operating range

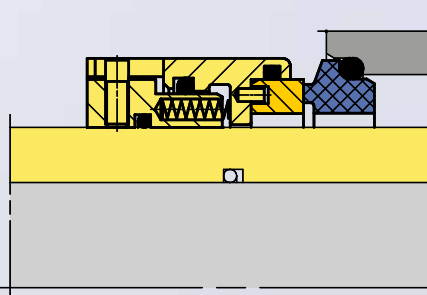
Shaft diameter: $d = 170 \text{ mm}$ (6.69")
 Temperature: $t = \text{max. } 15 \text{ }^\circ\text{C}$ (59 °F)
 Pressure: $p = 2 \dots 16 \text{ bar}$ (29 ... 232 PSI)
 Speed: $n = 735 \text{ min}^{-1}$



Full power: Platforms with many individual current turbines floating in the tides generate clean energy.

Project "Triton"

The Triton platform system enables the installation of any number of current turbines from different manufacturers. The individual turbines are mounted to a supporting structure that is lowered either partially or fully into the ocean and then anchored to the seabed. The platform can be turned to a position that allows easy access for maintenance work. The Fundy Ocean Research Center for Energy is currently testing the Triton T36 in the Bay of Fundy in the Canadian Nova Scotia. The newly developed platform is fitted with 36 Schottel Hydro SIT Instream turbines and supplies an output of 2.5 MW.



Utilized mechanical seals

EagleBurgmann marine mechanical seal type 19.9700.220.04

Features

- Single seal in semi-cartridge version
- Bi-directional
- Hard/soft face material combination
- Seawater protected multiple springs

Operating range

Shaft diameter: $d = 220 \text{ mm}$ (8.66")
 Temperature: $t = \text{max. } 35 \text{ }^\circ\text{C}$ (95 °F)
 Pressure: $p = 1 \dots 6 \text{ bar}$ (15 ... 87 PSI)
 Speed: $n = 60 \dots 200 \text{ min}^{-1}$

Color code technical drawings:
 Yellow parts rotating,
 blue stationary,
 gray: shaft and housing.