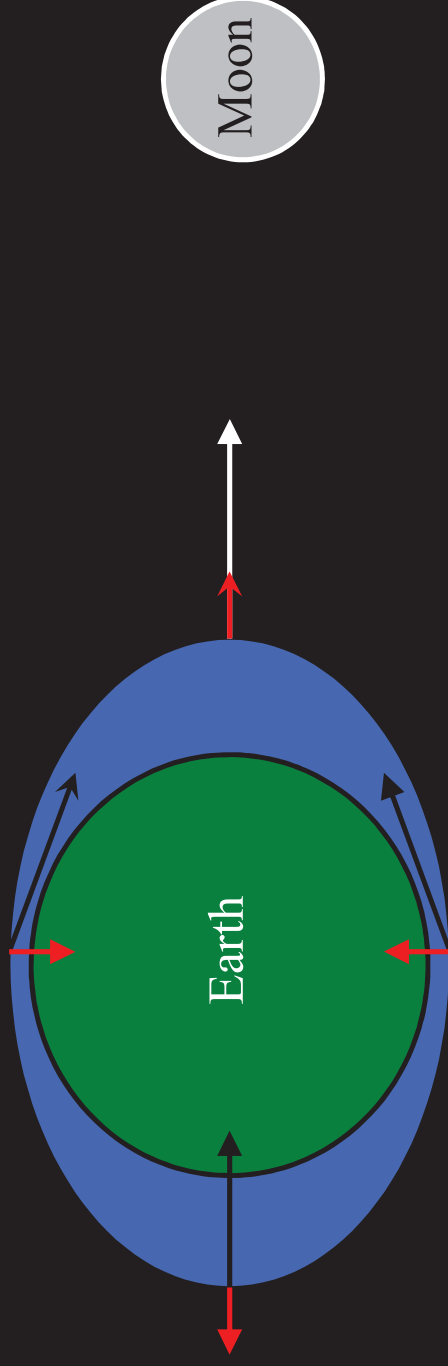


Tidal Energy

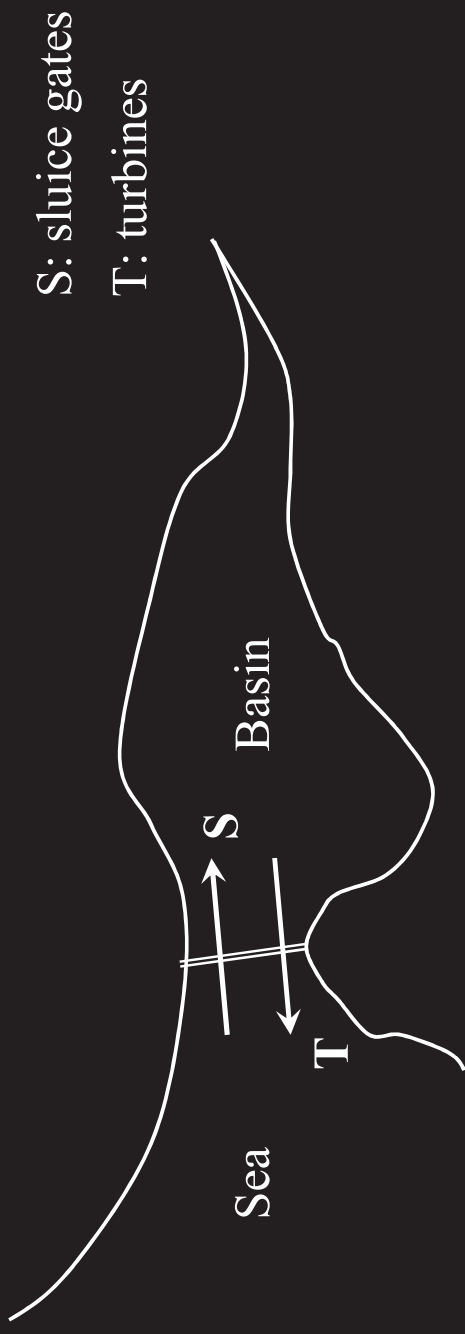


Gravity and the tides



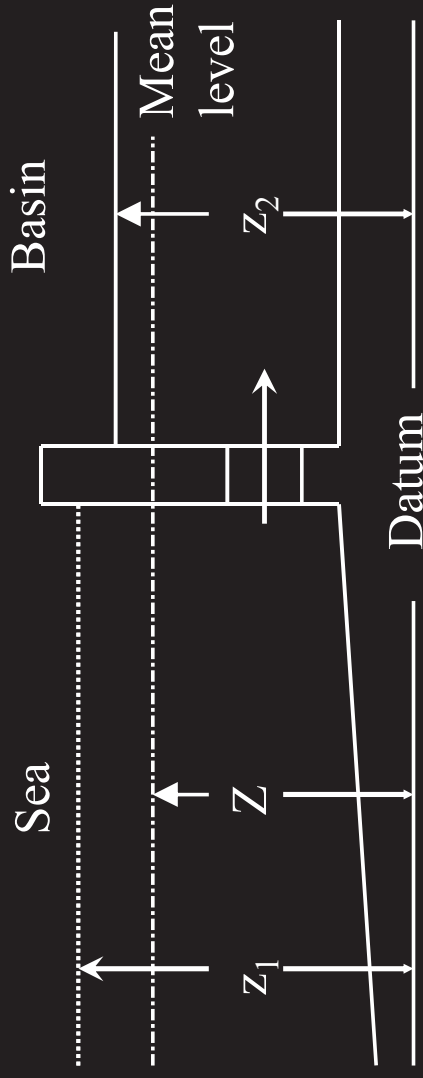
- ❑ Lunar cycle has a period of about 12h 25min.
- ❑ Tidal range would be very small (about 0.5 m) if the earth were covered in water. But the land masses interfere, and create large ranges in some parts of the world.
- ❑ Two power extraction methods: tidal range and tidal stream.

Tidal range: single-effect barrage system

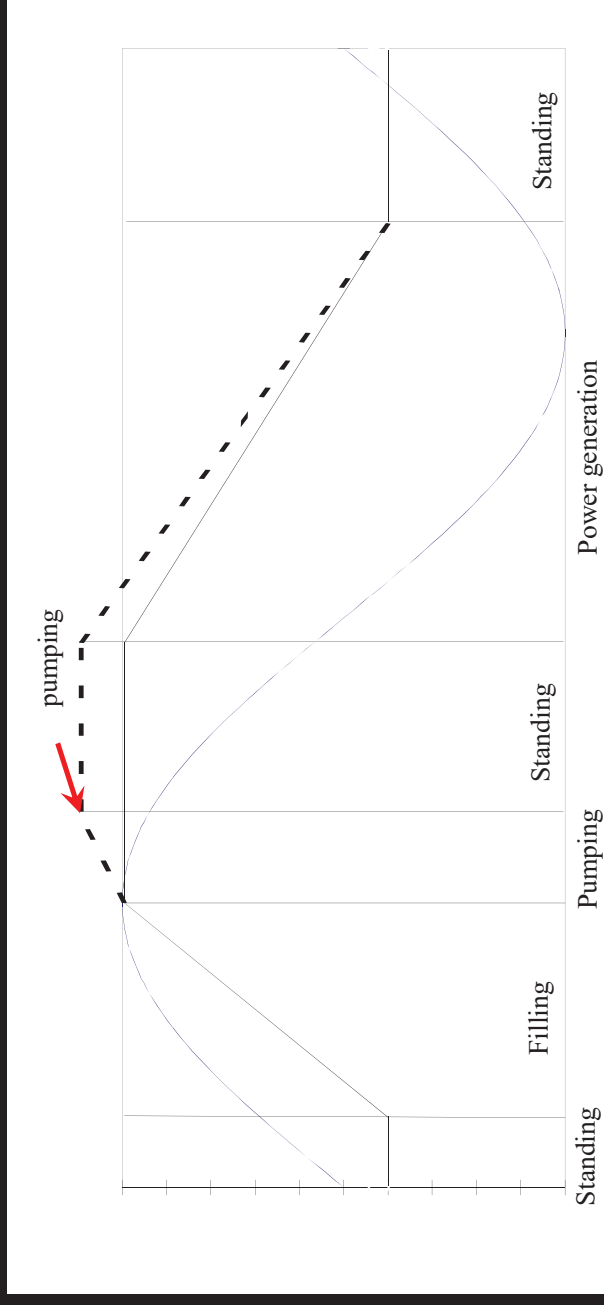


S: sluice gates

T: turbines

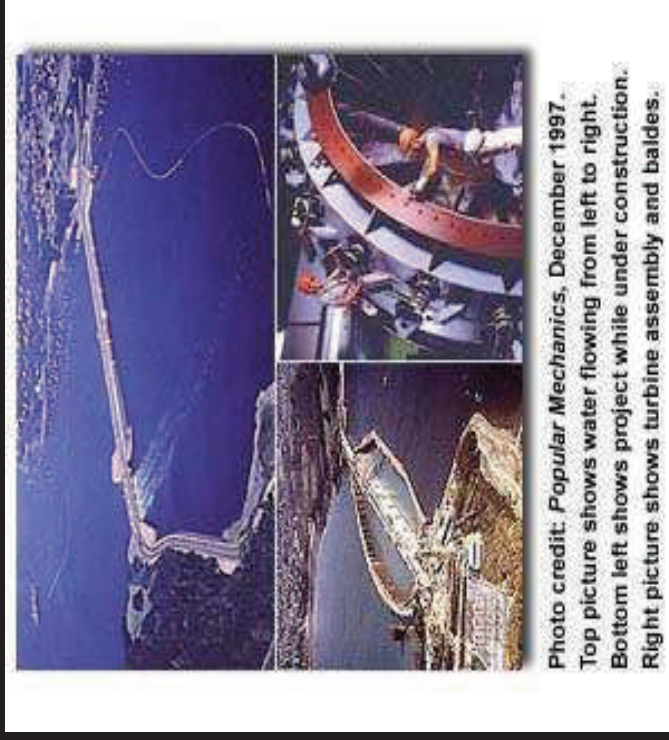


Operation of a single effect barrage system

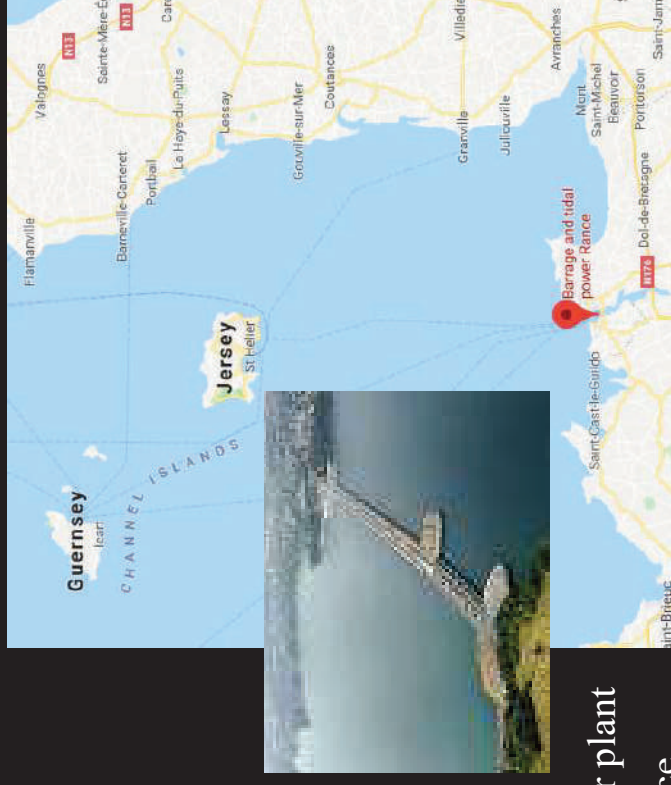


- ☐ Basin is filled through the sluices until high tide; sluice gates are closed.
- ☐ There may be pumping using grid electricity to raise the level further.
- ☐ Turbine gates closed until the sea level falls to create sufficient head across the barrage.
- ☐ Gates opened and turbines generate until the head is again low.
- ☐ Sluices are opened, turbines disconnected and the basin is again filled.

La Rance tidal barrage system, France

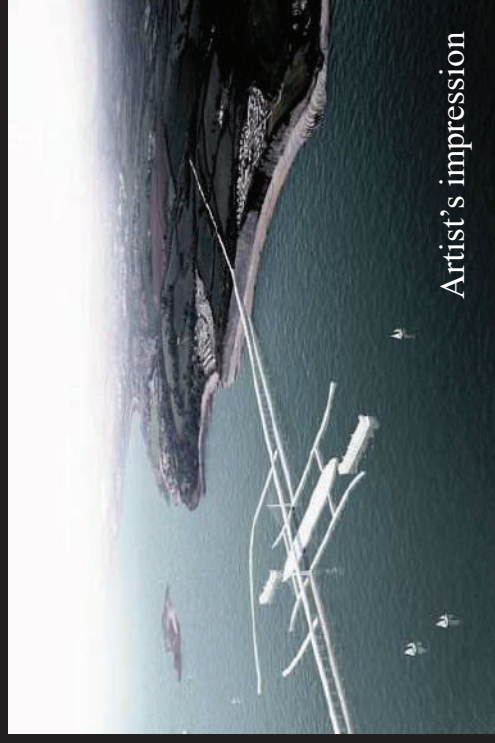


Power: 240 MW (from 24 turbines)
 Annual generation: 500 GWh
 Tidal range: 8 m
 Capacity factor: 28%
 Length: 700 m



- ☐ Location: Brittany, France
- ☐ Completed 1967
- ☐ Capital cost €94.5 million
- ☐ Operated initially as an experimental power plant
- ☐ Owned and operated by Électricité de France

Proposed Severn barrage, UK



Arguments against:

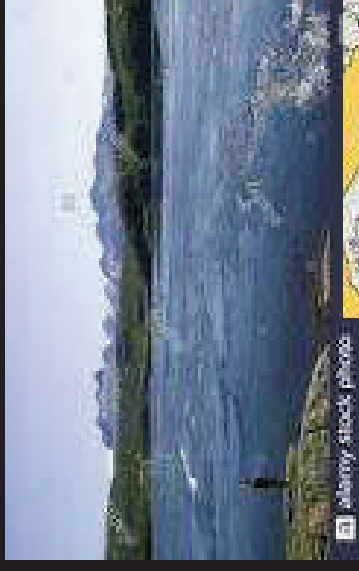
- ☐ Estimated cost: £34 billion
- ☐ Scale and impact would be unprecedented
- ☐ Major environmental impacts
- ☐ Other significant resources exist in the UK

- ☐ Length: 16 km
- ☐ Tidal range: 10 m
- ☐ Rated power: 7 – 12 GW

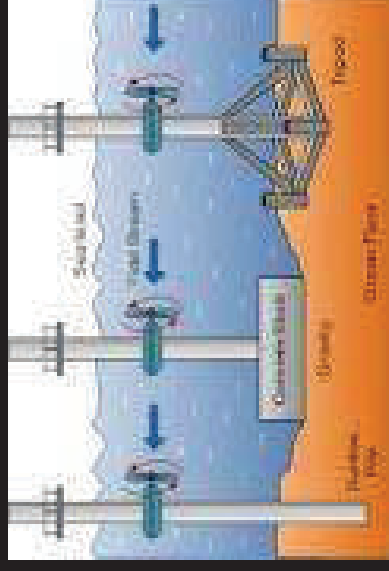
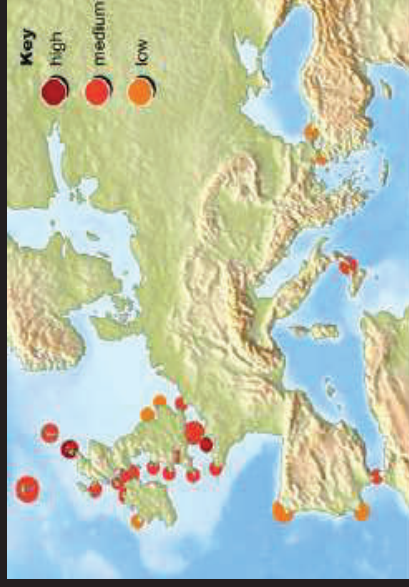
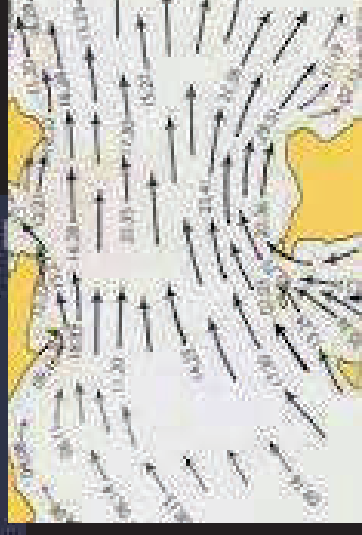


Tidal stream power extraction

- ❑ Conversion technology still immature.
- ❑ Proposed designs offer a wide variety of configurations and mooring arrangements.
- ❑ Three major contenders:
 - horizontal-axis turbines
 - vertical-axis turbines
 - oscillating hydrofoils
- ❑ Pentland Firth estimated at ~1.9 GW or ~40% of the total Scottish demand.



sherry-stocks photo

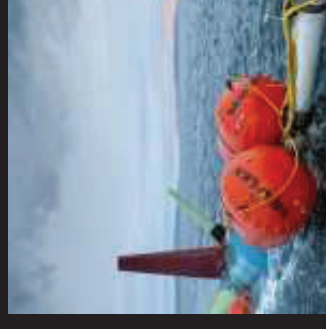
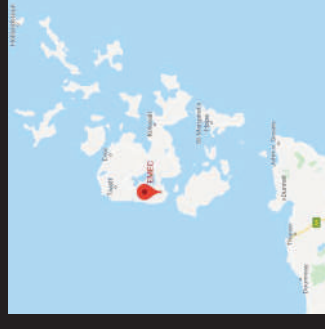
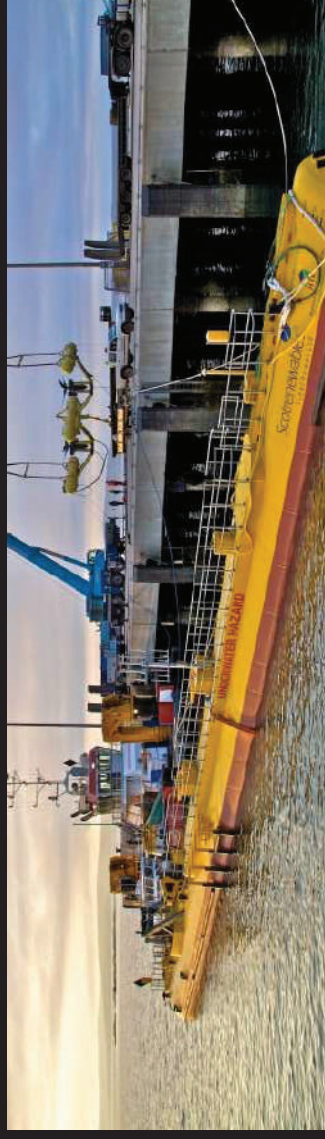


Aqua-RET 2012

European Marine Energy Centre (EMEC)

<http://www.emec.org.uk/>

- ❑ Established in 2003, located in Orkney
- ❑ Provides developers with accredited, open-sea testing facilities
- ❑ Maintains 14 grid-connected test berths and associated infrastructure



Stingray



Artist's impression

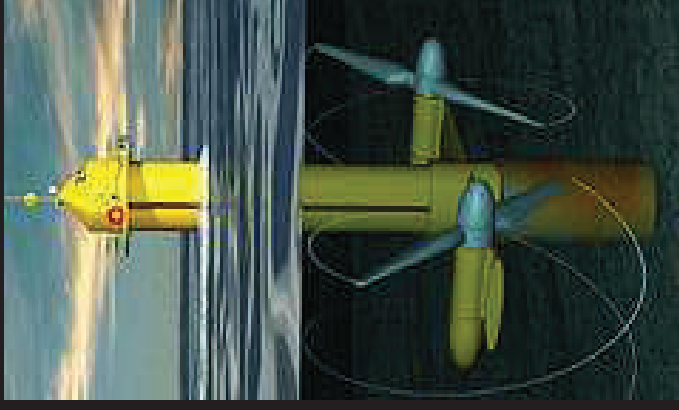
- ❑ Employs an oscillating hydrofoil.
- ❑ Hydraulic power take-off system.

Stingray trial in Yell Sound, Shetland, September 2002



❑ Device produced 90 kW output in a 1.5 m/s current.

Testing of prototype turbine near Lynmouth, Devon.



- ❑ Project managed by Marine Current Turbines Ltd.
- ❑ 300 kW rating - 2 blades, rotor diameter 11 m.
- ❑ No yaw mechanism and no electrical connection to shore.

- ❑ Artist's impression of a twin 2-bladed installation.
- ❑ Rotors contra-rotate to minimise the reaction torque on the structure.

Strom AS, Norway



- ❑ Rated at 300 kW, rotor diameter 20 m.
- ❑ Deployed in fjord near Hammerfest in 2003.
- ❑ Turbine has a tripod supporting framework with gravity ballast.
- ❑ Joint venture with ScottishPower to deploy a proposed 10 MW farm in the Sound of Islay, Scotland.

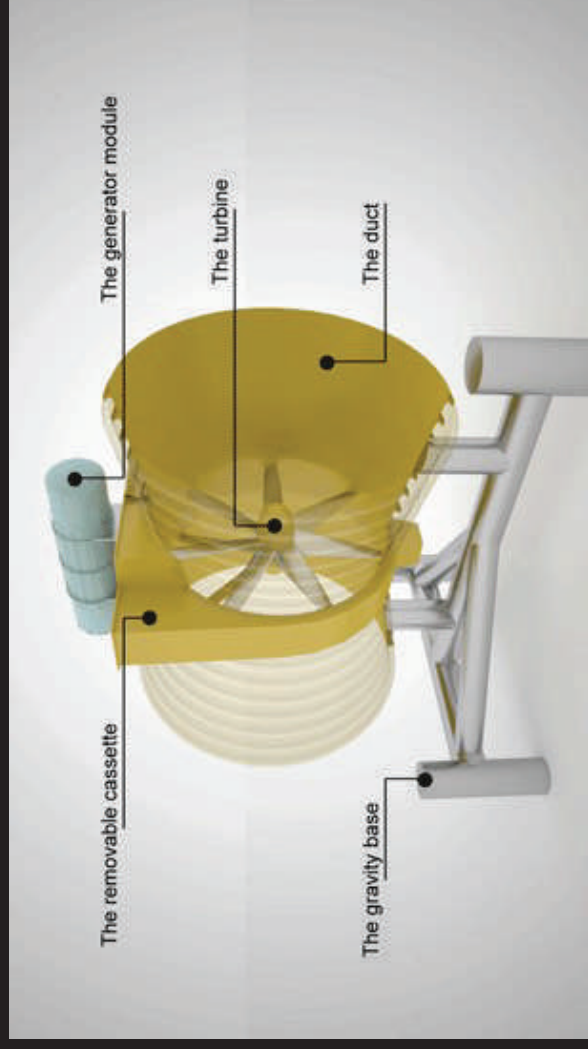
Open Hydro



- ❑ Hub-less design with a permanent magnet generator around the rotor rim.
- ❑ Rigidly mounted, accepts bi-directional flow.
- ❑ Prototype device has been evaluated at EMEC.
- ❑ Further demonstrator planned for Bay of Fundy, Nova Scotia.

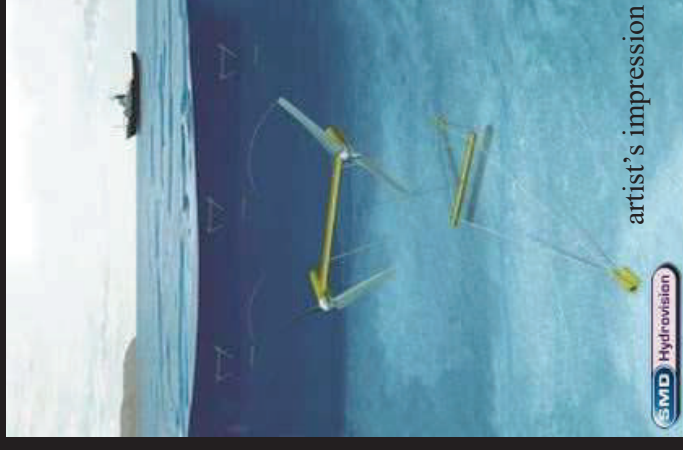


Lunar Energy



- ❑ Bottom-mounted, bi-directional device.
- ❑ Turbine and generator can be extracted from main structure for servicing.
- ❑ 1 MW prototype tested at EMEC in 2007.
- ❑ 8 MW farm proposed in joint venture with EON UK.

SMD Hydrovision

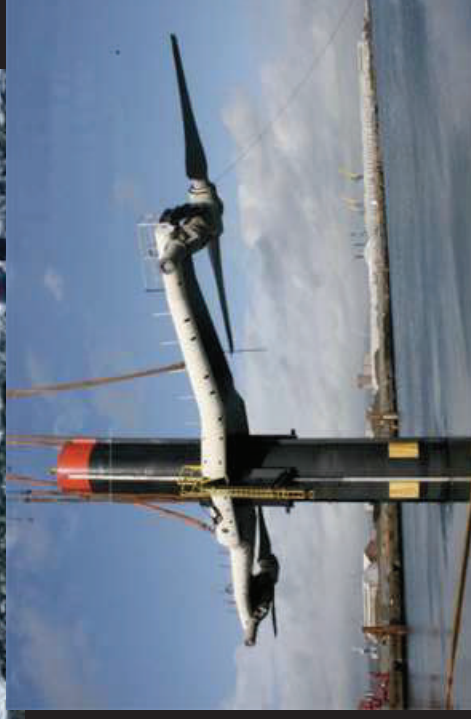


- ❑ Main picture shows 1/10 scale turbine on test site at NAREC UK.
- ❑ Features a moored buoyant structure for use in deep water.
- ❑ Full scale device has 2 rotors of 15m diameter, rated at 1 MW.

SeaGen



- ❑ Designed by Marine Current Turbines Ltd.
- ❑ Rated power output 1.2 MW.
- ❑ Twin 16m diameter rotors on a piled supporting column.
- ❑ Installed in Strangford Lough, Northern Ireland, 2008.



ME927 Tidal energy