

WAVE ENERGY PROJECT

The SEA Clam



Sea Energy Associates Limited

Rendel Palmer & Tritton

Coventry Polytechnic

Wave Energy - a source of clean, renewable energy ...

Ocean waves are created by wind passing over extensive stretches of sea. Because wind is originally derived from solar energy, waves may be considered to be a stored form of renewable energy.

The possibility of extracting energy from ocean waves has intrigued man for centuries but it is only in the past two decades that technically suitable devices have been proposed. In general these devices have few environmental drawbacks and enable electricity to be generated without contributing to the greenhouse effect and without the creation of by-products such as acid rain or radio-active waste.

The economic projections for some wave energy devices look extremely promising and especially so in areas of the world where the wave climate is energetic.

The north east Atlantic is a particularly favourable area where wave power averages around 70 kW/m.

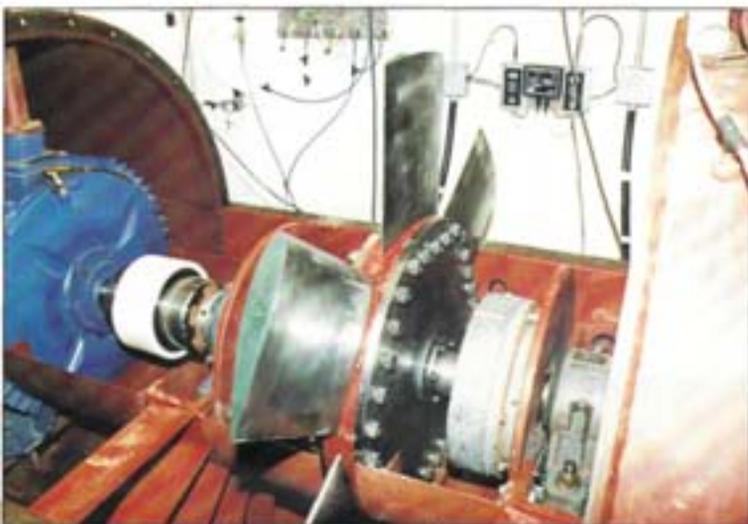
The total achievable UK resource for offshore floating devices has been estimated as 6 GW which is equivalent to 50 TWh of electrical energy per annum or 40% of the energy supplied annually by National Power. This is about one-third of the European wave energy resource.



The SEA Clam wave energy converter - model under test on Loch Ness

The SEA Clam Project ...

The SEA Clam is a simple device which uses the displacement of air to extract energy from sea waves. Twelve air chambers, the outer faces of which are formed by flexible rubber membranes, are placed around a floating ring structure.



Wells air turbine and generator

Differential wave action moves the membrane in and out forcing air to be interchanged between chambers. Wells Turbines placed in the manifolds between the air chambers extract power from the air flow.

The rigid torus structure, 60 m diameter or more, acts as a stable reference body and is moored a few kilometres offshore.

Typically a 25 MW scheme deployed off the west coast of Scotland would feature 10 SEA Clam units and produce over 50 GWh per year of electricity.

Participating Organisations ...

Sea Energy Associates Ltd (SEA). - A joint venture company formed by the inventors and industrial interests in the 1970's to develop and exploit wave energy. SEA has acted as principal in a large number of wave energy research contracts with the UK Department of Energy and carried out other research on its own account. It is the owner of the key patents relating to the SEA Clam device.

Coventry Energy Systems Group. - A team of engineers and scientists at Coventry Polytechnic who have acted as main sub-contractors to SEA on many research contracts. They were the original inventors of the Clam concept and have carried out all subsequent development.

Rendel Palmer & Tritton. - Consulting Engineers who were involved as assessors throughout the period of the national wave energy programme.



1982 tests on Loch Ness of the straight SEA Clam

State of Development

The team developed the first SEA Clam concept from 1978 onwards and tested the straight spine version on Loch Ness in 1982. This was declared by the Chief Scientist of the time as the most promising device to arise out of the national wave energy programme and to have the greatest potential for further development. This potential for further development was realised in 1984 when a large model of a circular version of the SEA Clam was tested on Loch Ness. The new configuration improved the productivity of the device by a factor of three with the same structural weight as the previous straight version. This remarkable improvement in performance is reflected in the predicted cost of power generated which is now seen as competitive with other renewables.



Current designs of the SEA Clam in steel and concrete (inset).

Since 1984 the development work has concentrated on structural design and computer modelling. New designs in steel and concrete have been produced by Rendel Palmer & Tritton which are economic and have the desired sea keeping qualities. Steel shipyard construction is appropriate for the first demonstration prototypes although concrete is seen as cost effective for the mass production of larger units. The working components, the bag membranes and air turbines, have been tested to a limited extent but need proving prior to going to sea.



The review of wave energy carried out on behalf of the Department of Energy during 1990/91 is confirming a much more promising costing and technical scenario for the new circular Clam, as compared to the 1982 report, which ranked the earlier straight Clam as first amongst competing devices. The SEA Clam is again the leading device identified in the new review in terms of development and potential cost of power. Offshore wave energy now meets the requirements of the "promising but uncertain" category which makes it eligible for government support.

The Way Forward ...

The potential for offshore wave energy has to be demonstrated by testing a full scale prototype. The SEA Clam is relatively simple and cheap to construct and commission. A development programme needs to prove the key components and optimise the design. The aim should be to carry out sea trials of a prototype by 1996.

Facts and Figures ...

Each device unit

Diameter	60 m
Depth	8 m
Width	7 m
Displacement	5000 tonne
Maximum power rating	2.5 MW

25 MW Scheme

Location	South West
No. of units	10
Water depth	50 m
Available average power	53 kW/m
Average annual output	5.7 MW
Capital cost	£23M
Cost per kWh generated	5 to 8 pence

Sea Energy Associates Ltd
17 Royal Crescent
CHELTENHAM
Glos GL50 3DA
Tel: 0242 239565
Fax: 0242 239566

Rendel Palmer & Tritton
61 Southwark Street
LONDON SE1 1SA
Tel: 071 928 8999
Fax: 071 928 5566

Coventry Polytechnic
Energy Systems Group
Priory Street
COVENTRY
CV1 5FB
Tel: 0203 838382
Fax: 0203 258597



Wave power estimates for UK offshore sites in kW/m