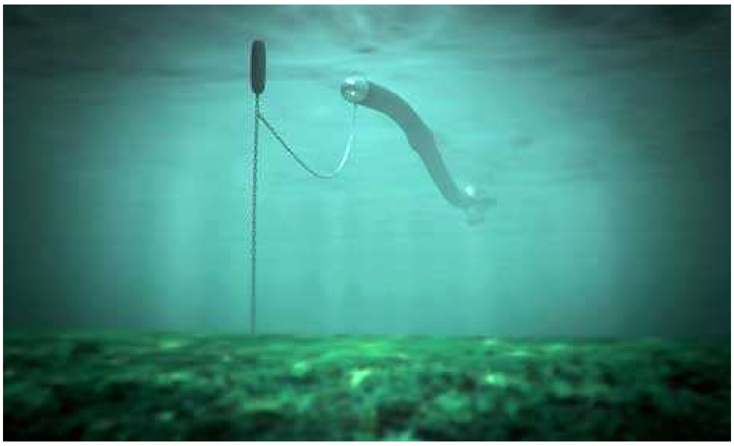
guardian.co.uk

New wave power generation

An experiment to harness the sea's energy could be helping to produce power within five years, according to its supporters

Michael Pollitt
The Guardian, Thursday August 7 2008



Computer simulation of how the Anaconda would look at sea

Professor John Chaplin of the University of Southampton likes solving fundamental fluid mechanics problems. But, say colleagues of this formidable theoretician, he also enjoys experiments in large water tanks. Chaplin has just been awarded £430,000 by the Engineering and Physical Sciences Research Council to find out how well an Anaconda wave energy converter will perform.

The Anaconda isn't his idea, though: it's the brainchild of semi-retired physicist Professor Francis Farley FRS and Professor Rod Rainey, head of floating structures at WS Atkins Oil and Gas. Farley has worked on wartime gunnery radar, particle physics and wave energy while Rainey is an expert on floating offshore structures.

Battle of the bulge

Farley and Rainey's invention is a giant rubber tube closed at both ends, filled with water and anchored in the sea with one end facing oncoming waves. It relies on "bulge" waves, which form inside when a passing wave squeezes the tube. As the bulge wave moves down the tube, the wave that caused it runs along the outside at the same speed - making the bulge wave inside grow even bigger. This action turns a power-generating turbine at Anaconda's far end.

Rainey first dreamed up the idea after thinking about Professor Michael French's Lancaster Floating Bag from the 1970s, which dampened wave action at harbour entrances. Rainey wondered about exploiting bulge waves and predicted a resonant interaction with the sea. "Not fully convinced by his formulae, I tried another mathematical approach and discovered to my surprise that the bulge should grow rapidly along the tube, running just in front of the wave," he says.

Some experiments then followed, gluing together thin rubber sheets to form water-filled tubes. "Great fun, but rather messy," says Farley, who has worked on several wave energy projects.

They then patented the concept and turned to John Chaplin at Southampton University who works on wave/structure interactions. "I get rung up once a month or so by mad inventors," he says. But, given their academic prowess, Farley and Rainey were worth listening to. "They came here with various tubes they'd built in their garages. We tried the idea out in one or two tanks," says Chaplin. Watching these experiments convinced him. "It seemed to have a very good prospect of escaping two big problems that all wave power devices have to face." These are generating power from modest waves and surviving rough seas.

Using a flexible material like rubber has an advantage. Normally, rigid wave energy devices are matched to wave frequency which determines a structural size. "The Anaconda escapes that because you can achieve similar resonance by making the speed of the bulge wave - the natural speed of the bulge wave in the tube - match the speed of the water waves outside," says Chaplin.

Now, a two-year EPSRC project (The Hydrodynamics of a Distensible Wave Energy Converter) will investigate Anaconda's potential as understanding the wave response is essential (it bulges, bends, twists, and stretches). In collaboration with its inventors and Checkmate SeaEnergy (which has a licence to manufacture), Chaplin and his colleague, Professor Grant Hearn, will undertake experiments and computational studies.

Powerful Anaconda

The Anaconda prototype is 25cm in diameter and in varying lengths with a simulated power take-off. Eventually, a turbine will use a unidirectional flow between high and low pressure tanks in the tail (water flows into one tank and out of the other thanks to one-way valves). Work with 50cm diameter tubes will investigate behaviour in different wave conditions, measure various parameters, and estimate power output.

A full-scale 100-tonne Anaconda will be 200 metres long and 7 metres in diameter. It will produce 1 megawatt (enough for 2,000 homes) at a cost of 6p or less per kilowatt hour.

Anaconda's development - rubber tube and power take-off - is at Checkmate Group's engineering division, Avon Fabrications. Making huge tubes is challenging although, in Rainey's view, rubber is a "pretty formidable marine material". He has no fears about the design despite wave power's "terrible history" of failure.

Farley believes that Anaconda has a good capture of wave energy, is flexible, and is cheaper than other devices. "We could see the first full-size device deployed off the UK coast in around five years' time," adds Chaplin.

Despite such confidence, energy expert Professor Ian Fells worries about Anaconda's survivability at sea. Fells has long been involved in marine energy and appreciates the difficulties (and great expense) of scaling devices up. "They have to think very seriously how well this will cope with very large waves which occur now and then," he says.