

CREATING A NEW AUSTRALIAN MARKET PLACE (OFFSHORE RENEWABLE ENERGY)



Report on SUT Perth Branch Evening Technical Meeting Wednesday, 30th April 2014

By Henry Sheil, Perth Branch Committee Member

A pleasant autumn evening in Perth on 30 April saw a packed house of 160 SUT members and guests gather at the Parmelia Hilton Perth for the second SUT Evening Technical Meeting for 2014.

The meeting opened at 6pm after initial refreshments were taken. Perth SUT Chairman Ray Farrier welcomed all and introduced Henry Sheil as Session Chair for the evening. Ray thanked the evening's sponsor: Mark Carlton, independent SUT member (employee of Neptune Marine) for his most generous personal contribution. Unfortunately Mark was unable to attend, however all were encouraged to raise a glass to Mark at the post-meeting drinks and nibbles.

Technical presentations featuring different technologies for gathering energy from ocean waves were given by:

1. Bombora Wave Power
2. Carnegie Wave Energy
3. Wood Group Kenny, with Global Renewable Solutions

The presentations are available from: http://www.sut.org.au/perth/sutau_perth_events_archive.htm

1. Award Winning Wave Energy by Shawn Ryan, Director, Bombora Wave Power

Shawn Ryan presented the patented Bombora wave energy system. The core technology of wave energy absorption by moving air within membrane compartments can also perform functions such as shoreline protection, marina and harbour wake and wave attenuation, marine biodiversity and habitat enhancement, as well as tourism. Units rated at ca. 1.5MW have been considered.

The presentation showed flexible membrane enclosures fixed to the seafloor, where the pressure changes from passing waves move the membrane, causing air inside to flow. Simple check valves cause the air to flow through a closed circuit between the compartments and to act on an air turbine located within the unit to extract electrical energy. Shawn discussed a vision for near shore wave farms, analogous to current wind farms.

Bombora has examined various world locations and water depths for energy resources, identifying wave statistics and considering the energy densities and survival conditions. Locations in Portugal and Ecuador were compared by way of example. The proposed unit size would extract energy over a wave width of ~80m, larger than many competitors. The design considers overloads at end stop conditions, interactions with aquatic life and humans, suitable materials of construction, and use of existing off the shelf components, all with a view to achieving acceptable costs, the key to success.

Phase 1, theoretical analysis, independent concept validation and tank testing have been done. Phase 2 proposes a small scale trial on the Swan River foreshore at Como to demonstrate river edge protection. A floating pontoon with membrane wave energy system attached is also mentioned.

2. The Perth Wave Energy Project - Design and Construction Update by Jonathan Fiévez, Chief Technology Officer, Carnegie Wave Energy

Jonathan Fiévez presented an update on the Perth Wave Energy Project (PWEP) which is currently being constructed by Carnegie Wave Energy approximately 3 km west of the southern end of Garden Island near Perth. The project is expected to be commissioned in mid 2014.

The PWEP employs three 5th generation CETO wave energy converters to feed an onshore power station, where hydraulic energy is converted to electrical power and/or desalinated water.

The 5th generation (CETO 5) wave energy converter design has been developed over the last decade by Carnegie in Perth. It comprises a fully submerged buoyant actuator (BA) which is moved in an orbital fashion by the waves. A pump/piston within the BA is thus stroked in and out, and appropriate check valves cause high pressure hydraulic fluid (water) to flow in one

direction within a closed circuit, which can feed a turbine located either ashore or within the CETO buoy itself. The CETO technology can be used near-shore or in deep water, and the power can be transmitted by electric cable or piping.

Three 1kW prototypes were tested at Fremantle in 2008, and an 80kW unit at Garden Island in 2011. Three larger 240kW units are presently being installed at Garden Island as the PWEF. Carnegie has designs for 1MW units to be demonstrated in 2016. A commercial scale project is foreseen as requiring 25 1MW units in a suitable location, and could be possible from 2018.

Jonathan identified that numerical modelling of power, loads and motions is critical to developing and cost reduction of the CETO technology. Carnegie developed simple frequency domain models and more demanding time domain and computation fluid dynamics (CFD) models using an iVEC supercomputer. The BA units are instrumented with more than 500 sensors to help in understanding performance, and model validation, with data sampling of some parameters up to 100 times per second.

The onshore power plant will be 3.2 km from a row of 3 offshore BA units, connected by two 100mm bore 210 Bar flexible pipelines. The power plant will include electricity generation and a pilot reverse osmosis desalination plant, either of which can utilise up to 100% of the energy extracted.

The status as of 30 April is the pipelines and offshore foundations are installed, the BAs delivered, the pump units manufactured, and the fibre buoy tethers manufactured and tested. The foundation connectors for the BA have been manufactured and tested, and onshore plant construction has started.

Carnegie has received Commonwealth and WA state grant funding, and has also licensed the CETO technology to EDF, the French electricity utility. Carnegie expects to operate the PWEF plant, gathering performance data and earning revenue, from Q3 of 2014.

Looking to the future Jonathan anticipates a commercial scale CETO 6 unit of 1MW capacity, 4 times greater than CETO 5, requiring a buoy diameter increase of ~50%. CETO 6 may include internal power generation with a power cable back to the power user. Candidate locations further out from Garden Island, and at the "Wave Hub" facility in Cornwall, UK, are being considered.

3. The Energy Island Platform – Offshore Renewable Energy's Future by Phil Brown, Regional Director, Wood Group Kenny and Eoghan Quinn, Project/Technical Manager, Global Renewable Solutions

Phil Brown of WGK presented "Power Platform", an innovative renewable energy concept developed by WGK on behalf of GRS. The concept represents a low-risk approach to harnessing renewable energy thorough integrating proven solutions in offshore wind turbines and oscillating wave columns on a platform design based on offshore oil and gas technology and experience.

It comprises a triangular steel gravity-based structure with two 1.5MW oscillating water columns at each corner, and a 7MW wind turbine, suitable for a 20-30m water depth. Total peak potential capacity is thus 16MW. A cluster of multiple Power Platforms could be linked together to form an Energy Island connected to shore by submarine cable.

WGK GRS first prepared a project basis of design. Then they did structural analysis, stability analysis, motion analysis, constructability assessment, an execution plan and cost estimates. The prime focus was to find a safe and robust concept with minimum CAPEX and OPEX.

The structures are towed afloat to location, and ballasted in place without requiring an extensive offshore spread. The possibilities for nearby local construction and maximising assembly and pre-commissioning while avoiding the need for large marine cranes were exploited.

Eoghan Quinn outlined GRS' primary role as integrators rather than developers of technology. GRS has performed tank testing and numerical modelling of the concept, using partners HMRC in Ireland and WavEC in Portugal. A good fit has been obtained between analysis and testing data (within 5%). The concept was assessed for a candidate site in the west of Ireland.

There were questions and answers after each presentation.

In the customary fashion Ray Farrier, Perth Branch Chairman, then called on the audience to thank the presenters for their most valuable contributions. He then invited the dialogue to continue in a more convivial setting, over drinks and nibbles provided most generously by Mark Carlton, which we did. The evening adjourned at 9:30pm.