MAINTENANCE PLAN

Pilot Project off Locks Well, South Australia

Prepared for

The Department of Sustainability, Environment, Water, Population and Communities

Rev 2

July 2012

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1 INTRODUCTION

1.1 Background

Renewable energy is an essential part of Australia's low emissions energy mix and is important to Australia's energy security. It plays a strong role in reducing Australia's greenhouse gas emissions and accordingly, the Australian government is supportive of renewable energy industry development.

In line with Australia's need for renewable energy sources, Wave Rider Energy has proposed to locate a Wave Rider pilot plant in the high energy waters off Locks Well Beach, South Australia for up to 18 months. The greatest advantage is that the Wave Rider does not produce any greenhouse gases, harmful wastes or pollutants when converting wave energy into electrical energy. Therefore during operations, converting wave energy is virtually non-polluting, with significant benefits in the form of mitigating climate changes, securing energy supply and decoupling economic growth from resource use.

The Wave Rider, spanning approximately 111 m length, 13 m width and 4 m height, will be moored to the seabed approximately 800 m from shore at a depth of 28 m using a system of chains, grommets, ground rings and anchors. The Wave Rider is designed to float with about one-third of the device above the surface and two-thirds being underwater (Wallbridge & Gilbert 2012).

The Wave Rider project was referred to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) for assessment under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). After providing Preliminary Documentation (refer to 2009/4859), the project was approved with conditions.

1.2 Conditions of project approval

The Wave Rider pilot project was approval subject to the following conditions:

- A towing and decommissioning plan be submitted and approved prior to the action occurring
- A maintenance plan be submitted and approved prior to the action occurring
- A monitoring and management plan for Southern Right Whales, Pygmy Right Whales and Australian Sea lions be submitted and approved prior to the action occurring
- A monitoring and management plan for EPBC listed birds be submitted and approved prior to the action occurring
- A compliance report is submitted annually

- An independent auditors report is submitted.

This plan details the monitoring activities associated with the Wave Rider.

2 SUMMARY OF INSPECTION AND FREQUENCY

The table below provides a summary of the various types of inspections and the frequency of when they will be carried out.

Table 1 – Summary of inspection type and frequency of inspection

Type of inspection	Frequency of inspection
Mooring system	Regular schedule: every three months or after every storm or severe weather event
Truss, Pontoons, Mechanism and electronic devices	Continuous monitoring (via video surveillance) Regular site inspections by boat
Research and development (steel performance samples to be collected for University research project)	three months from deployment nine months from deployment
Marine and safety lights	Continuous monitoring (via video surveillance) In situ inspection 3 and 9 months from deployment
Climate conditions	Continuous monitoring (via video sampling) Weekly random sampling
Rubbish	Continuous monitoring (via video sampling) and removal as required

3 DETAILED MAINTENANCE PLAN

The Wave Rider pilot plant will be moored at Locks Well for a short period of time of 12 to 18 months to trial the technology. Maintenance and monitoring activities throughout this period are described below.

3.1 Wave Rider structure

The Wave Rider device is made up of five parts:

1. The mooring system (AMOG Consulting, 2011) which includes three 12t anchors, a mooring ring, 1350m of wire rope, a riser chain as well as 200m of hawser grommet and two 10t surface buoys.

2. Two large 111m steel trusses which make up the majority of the structure.

3. Seven pontoons that interlink the two trusses and provide the buoyancy of the Wave Rider.

4. The wave energy generating mechanism which includes 144 internal buoys that move up and down inside the truss as well as well as chain and two long shafts on top of the structure.

5. Electronic devices like generators and various sensors that collect data during the trial.

Each of the above parts and components have been designed and constructed in a way to withstand the substantial forces in the sea. All mooring components have been assessed and successfully passed tests by international class societies “American Bureau of Shipping” and “Lloyd’s Register” for use in severe offshore conditions. Despite the high quality components, continuous monitoring and inspection will be carried out to monitor the condition of each part to identify any potential faults.

- *Mooring system inspections*: Whilst the mooring system is designed for extreme weather conditions it is necessary to inspect the mooring system at least every three months or after every storm event to make sure that all components on the seabed are still in the designated positions. An autonomous underwater vehicle (AUV) will be used to inspect the seabed as well as use of divers will be made. An experienced marine contractor will carry out regular inspections. Should any of the components have moved away from their regular positions they will be readjusted. This contractor also installed the whole mooring system and is therefore ideally suited to carry out the task.

- *Truss inspections:* The truss is made of carbon steel grade 250 and is coated with three layers of EPA approved anti-corrosive painting. It has 188 strain gauges which will be used to remotely monitor the steel performance during the pilot period

on a continuous basis. In addition to the remote monitoring the marine contractor will also carry out regular monitoring visits by boat to check the integrity of the Wave Rider. Should remote monitoring fail more frequent visits will take place.

- *Pontoon inspections:* The pontoons are made of carbon steel grade 300 and are coated with three layers of EPA-approved anti-corrosive painting. Sensors have been fitted in the pontoon to indicated structural integrity and water leakage. In addition to the remote monitoring the marine contractor will also carry out regular monitoring visits by boat to check the integrity of the Wave Rider. If required the contractor could also repair any damaged pontoons during the operation.
- *The Mechanism:* The wave energy mechanism is the most important part of the Wave Rider. It comprises 144 sub-surface buoys, a chain system as well as two long shafts on top of the structure. The buoys then move up and down in the truss as a wave passes. This movement causes the rotation of a shaft on top of the structure that is connected via a chain system, which in turn drives various generators that convert the kinetic energy into mechanical energy. All parts for the mechanism are made of stainless steel. A video camera on top of the structure will be used to monitor the performance throughout the trial-period. Should any of the mechanism components be damaged, no maintenance will be carried out during that time. Reason being that the main objective of the trial is to check the behaviour of the structure in the water during the different seasons and collect as much data as possible. Whilst it is important to test the mechanism, electricity output is not the priority at this stage as the structure will not be grid connected. Hence, should for example one of the buoys fail during the operation it is not so critical to repair this as the structure will still work even if multiple buoys were to fail. Furthermore, the Wave Rider will only be in the ocean for a relatively short time. It will be a different situation once a commercial Wave Rider is in operation and grid connected.
- *Electronic devices:* There a number of electronic devices mounted onto the structure, mainly strain gauges and a variety of other sensors with the aim to collect data on the performance of the Wave Rider. All these electronic devices are connected with wires to a control box which then wirelessly transmits the data to the Wave Ride office in Adelaide. All wires are shielded with a few layers of high quality material that protect the wires from malfunction. As a contingency all electronic devices have a backup system to prevent the operation from breakdown.

3.2 Maintenance strategies

Gaining access to the Wave Rider for routine servicing and emergency maintenance is difficult in severe weather conditions due to wave heights, wind speeds and the structure being in a motion. The traditional and feasible method for transporting personnel and equipment is by boat, which will be limited to a relatively calm sea condition. Accordingly, monitoring strategies have been developed using video technology wherever possible.

Maintenance strategies are defined below:

- *Remote monitoring*: carried out on a daily basis to inspect the condition on site via the wireless video camera. There will be no maintenance carried to rectify any faults unless the integrity of the structure is jeopardised upon which the service of a marine contractor will be utilized.
- *Corrective maintenance*: This is the type of work that requires repair soon after any component is damaged. Components in question include the mooring system, the pontoons, the masts that have the marine safety lights attached as well as the marine safety lights themselves.
- *Opportunity maintenance:* This is the type of work that will be carried out on demand and also preventive maintenance will be carried out at the same time.
- *Periodic maintenance:* These are the scheduled visits where preventive maintenance is performed to rectify any issues as deemed necessary by the dedicated maintenance crews. This includes removal of any waste that may accumulate on or around the Wave Rider structure.
- *Decommissioning:* In the event of unrepairable damage to the structure, the Wave Rider will be decommissioned.

3.3 Waste Removal

Due to the high energy waters it is unlikely that any waste or debris will accumulate on or around the structure. However, should waste around the Wave Rider be observed through the camera or physical inspections, Wave Rider Energy will assign a contractor to remove it manually from the standing platforms by means of an extended pole with a small hook as soon as weather conditions permits it or use divers to carry out the task if any waste cannot be reached from the platforms. As it is unlikely for waste to accumulate around the structure it is also uncertain what type of waste it could be, but it would likely be foreign objects in the water or any detached equipment. Should any waste be observed, it will be collected and noted in the Wave Rider Energy project documentation. At the end of the project this data will be evaluated along all other data collected. It is not envisioned that any environmental clean-up will be required due to equipment damage and failure. The Wave Rider is a fully mechanical system which means it is completely dry and has no risk of any leakages of fluids into the ocean. Should any equipment be damaged and not jeopardise the integrity of the whole structure, it will not be repaired. Should any equipment detach it would likely be in a very heavy storm. After such an event all moorings and the seabed would be routinely checked and any detached equipment would then be collected. Wave Rider Energy also has a temporary lease of the seabed with the South Australian government which means that upon the completion of the project the whole structure including all mooring components will be removed and the area returned to its original condition. Once the Wave Rider has been removed including all components, an additional benthic survey will also be carried out.

4 CONCLUSION

Operation and maintenance of offshore structure is more challenging than onshore structures due to the fact that severe weather conditions can make things more complicated and limit the ability for servicing and maintenance. Harsh winter storm conditions may make it totally inaccessible for a number of days due to sea, wind and visibility conditions. Furthermore, this pilot project will be in the water only a relatively short amount of time with the priority being the observation of the behaviour of the overall plant. Therefore, the level of offshore maintenance on the structure is expected to be quite minimal and will mainly focus on the safe operation of the structure and the regular inspection of the mooring system. Remote monitoring via the video camera in lieu of on-site monitoring will therefore be used whenever possible.

5 REFERENCES

AMOG Consulting (2011). “Single Point Mooring System – Final Design.” T2010.j085.002.0.

Wallbridge & Gilbert (2012). “Wave Rider Mooring Design and Installation Project”. Prepared for Wave Rider Energy.