WAVE RIDER MOORING DESIGN AND INSTALLATION PROJECT

Locks Well Beach, South Australia

WAVE RIDER ENERGY TOWING PROCEDURE

Prepared for Wave Rider Energy Pty Ltd
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REVISION HISTORY

REV	DATE	COMMENT	SIGNATURES		
			Originated By	Checked By	Authorised By
A	06/03/2012	Draft	LC	LVC	LVC
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INTRODUCTION

The following report prepared by Wallbridge & Gilbert (W&G) summarises the Towing Procedure for the Wave Rider pilot plant at Locks Well Beach, South Australia. An assessment of the project's interactions with the marine environment is also included.

EXECUTIVE SUMMARY

Innovative technology to convert wave energy to electrical energy has been developed by Wave Rider Energy Pty Ltd (Wave Rider Energy). With the growing demand for electricity coupled with increasing social pressure and requirements to reduce greenhouse gas emissions, renewable energy technologies such as the 'Wave Rider' must be responsibly explored for commercial and environmental viability.

Wave Rider Energy has proposed to locate a Wave Rider pilot plant in the high-energy waters off Locks Well Beach, South Australia. The Wave Rider (Figure 1), spanning approximately 112 metres in length, 13 metres in width and 4 metres in height, will be moored to the seabed approximately 800 metres from shore at a depth of 28 metres using a system of chains, grommets, ground rings and anchors. The Wave Rider floats with approximately one-third of the device above the surface and two-thirds underwater.

Figure 1: The Wave Rider: innovative technology to convert wave energy to electrical energy.

To travel to site, Wave Rider Energy proposes to use existing open water shipping routes. The towing journey is likely to take 5.5 days as the towing vessel speed will be 2 knots.

Towing procedures have been fully developed and analysed by AMOG Pty Ltd (AMOG). Procedures have been established and documented for pre sail-away checks, connection of hawser grommet during tow, emergency disconnection of tow assembly and connection of emergency tow assembly. The towing assemblies for open water tow and emergency tow have been analysed and sized in terms of metocean conditions and the required bollard pull.

To secure the Wave Rider and maintain public safety, a seafloor area of 64 hectares is required. The potential marine effects to that area have been assessed, as well as those from towing, mooring and decommissioning of the Wave Rider. The Government of South Australia and associated Departments have approved the project, recognising its environmental impact and acknowledging the consequent mitigation measures that have been developed.

The marine environment at Locks Well Beach is largely characterised by bare sand and several species of invertebrates, fish, birds and marine mammals occurring in the vicinity. In the context of effects on the marine environment, the placement of the pilot Wave Rider at the Locks Well Beach site is desirable because:

- There is little to no effect on seagrasses
- The risks associated with seabirds and marine mammals have been rated as low or negligible by relevant experts.

Three environmental effects of the Wave Rider during the towing phase have been identified, namely physical damage to marine flora, injury and death of seabirds and marine mammals from collisions and transfer of introduced pest species. These risks have been rated as low to moderate if there were no control measures in place. Regardless, Wave Rider Energy has proposed control measures to further reduce these risks, which include:

- Minimising physical damage to marine flora by using an established towing route between Port Adelaide and Locks Well Beach,
- Minimising collisions with seabirds and marine mammals by towing the Wave Rider at a time when fewer birds are in the region (May to September), and using bird-alerting devices including flight diverters, tori lines, bright coloured paint, flags and lights,
- Reducing the chance of transferring introduced pest species by mooring the device for only a short period of time, and using an environmentally friendly antifouling surface treatment to protect the device from corrosion and barnacles.

As the Wave Rider is to operate as a pilot, Wave Rider Energy is committed to monitoring and documenting the interactions of this new technology with the surrounding environment, through well-developed and comprehensive adaptive management and monitoring programs.

It should be noted there are no listed marine flora species relevant to EPBC and this project.

DETAILED REPORT

1. INTRODUCTION

1.1 Project Overview

Wave Rider Energy plans to install a prototype wave energy device ('Wave Rider') approximately 800 metres offshore at Locks Well Beach in South Australia. The Wave Rider will be held on station using a tri-catenary mooring connected via a hawser assembly and wire rope bridle.

Proven to work under laboratory conditions, the Wave Rider now requires in situ field testing under natural wave environments. The Wave Rider pilot plant will nominally operate for 18 months, collecting data to assess the longer-term viability of this technology as a renewable energy source. Development Plan Approval has been awarded by the State's Development Assessment Commission for the Wave Rider pilot plant to be located in coastal waters at this location. In addition, approval for a lease was awarded by the Minister for Transport for the commissioning of the pilot plant at Locks Well. The proposal was also referred under the *Environmental Protection and Biodiversity Conservation Act 1999* and subsequently granted conditional approval with the implementation of an environmental management plan.

The project can be divided into three distinct phases:

- Towing the Wave Rider to and from site
- Mooring and decommissioning
- Operating the Wave Rider.

This document relates to the towing phase of the project (Figure 2), and outlines the towing procedures that have been developed. These procedures include the preparations to be undertaken prior to a tow, principal towing arrangements, emergency towing arrangements and procedures for their use, as well as emergency disconnection of towing gear. The operational, emergency and equipment use procedures have been analysed.

Figure 2: Using a tug boat to tow the Wave Rider.

For the purpose of simplicity, the Wave Rider can be considered as an open trussed ‘ship’ that will be moored for a period of up to 18 months, collecting data regarding the efficiency of converting wave energy into electrical energy.

The innovative technology of the Wave Rider is a step in the right direction to encourage the use of renewable energy in Australia.

1.2 Purpose of Document

The intention of this document is to comply and facilitate authorisation from the Australian Department of Sustainability, Environment, Water, Population and Communities to commence the project. The documentation of towing procedures includes:

- Equipment aboard the device and procedures for its use,
- Operational and emergency procedures, and
- Analyses in support of the above to demonstrate compliance.

In addition, this document presents an environmental management plan, including:

- An analysis of marine environment,
- An assessment of interactions between the Wave Rider and the marine environment, and
- Management and mitigation methodologies to ensure protection of the environment during mooring, towing, decommissioning and operating stages.

This document is not intended to present procedures for towing and manoeuvring of the device or operations which could reasonably be expected to be addressed by a qualified tow master.

2. THE WAVE RIDER PILOT PLANT

2.1 Location

The Wave Rider pilot plant will be towed from Port Adelaide to its ultimate destination at Locks Well Beach (the centre of the site is given as coordinates 135° 0.517'E, 33° 44.505'S). Suitable mooring conditions (e.g. thick sandy sediment) exist in a 2 square kilometre area from the centre of the site and extend 3 kilometres northwest towards Elliston (Geosonics Australia 2010). The Wave Rider will be moored approximately 800 metres from shore at a depth of 28 metres (Figure 3).

Figure 3: Approximate operating location of the Wave Rider at Locks Well Beach, South Australia.

Black rectangle – centre of site 135° 0.517'E, 33° 44.505'S). The seafloor area of 64 hectares needed to secure the Wave Rider infrastructure and maintain public safety is shown (black circle). Other suitable mooring conditions extend 3 kilometres northwest towards Elliston (black line).

2.2 Description

The pilot plant (Figure 4) will be of experimental size and have the following specifications:

- Length: 112 m
- Width: 13 m
- Height: 4 m
- Draught: 2.65 – 3 m
- Material: Carbon Steel
- Truss weight: 130 tonnes
- Pontoon weight: 60 tonnes
- Total weight: 290 tonnes (including axles, generators and buoys)

The Wave Rider will be towed to its destination using a tug boat. It is noted that the triplate of the primary tow arrangement, connecting the towing/mooring bridle will, under slack line conditions, hang approximately 19 metres below the waterline.

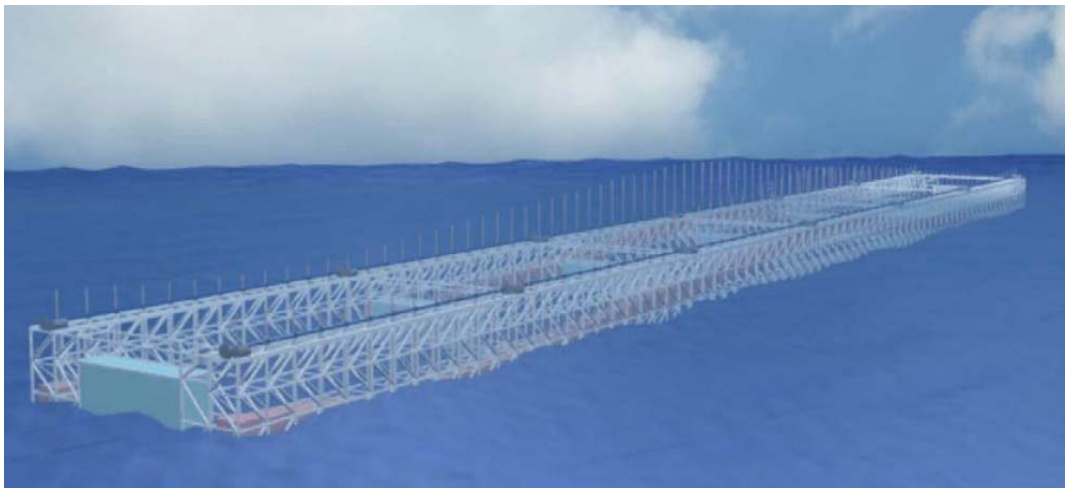

Figure 4: Modelled view of the Wave Rider.

The Wave Rider will be moored to the seabed using an Admiralty-type single point mooring consisting of the following major components (Figure 5):

- Three high holding power drag anchors, set on the circumference of a circle at approximately 1200 intervals
- Three ground chains, running along the seabed from a connecting shackle on each anchor to a mooring ring
- A riser chain from the shackle to a buoy on the surface
- A nylon hawser running from the riser chain, along the water surface, possibly with intermediate buoys to provide additional buoyancy
- A short 'tail' of chain, which will be shackled to the Wave Rider
- The integrity of the mooring will be regularly checked by SCUBA divers for the duration of the pilot study.

The pilot plant is designed to float with approximately one-third above the surface and two-thirds of the device being underwater. To secure the Wave Rider infrastructure and maintain public safety, a seafloor area of 64 hectares is required.

The Wave Rider uses a series of buoys to convert the vertical movement of the waves into mechanical energy. As waves pass, the buoys move up and down and this movement causes the rotation of an axle that is connected via a chain, which in turn drives a generator that converts the mechanical energy into electrical energy. The axle and generator are above the water.

The Wave Rider will operate mechanically meaning that no fluids are involved, unlike other competitors' systems which make use of hydraulics. As such there will not be any danger of fluids leaking into the water. The Wave Rider will receive an environmentally friendly antifouling surface treatment to protect it from corrosion and barnacles.

At the completion of the pilot, the project area will be restored to its natural state, as stipulated within the Department of Planning, Transport and Infrastructure (DPTI) seabed lease conditions.

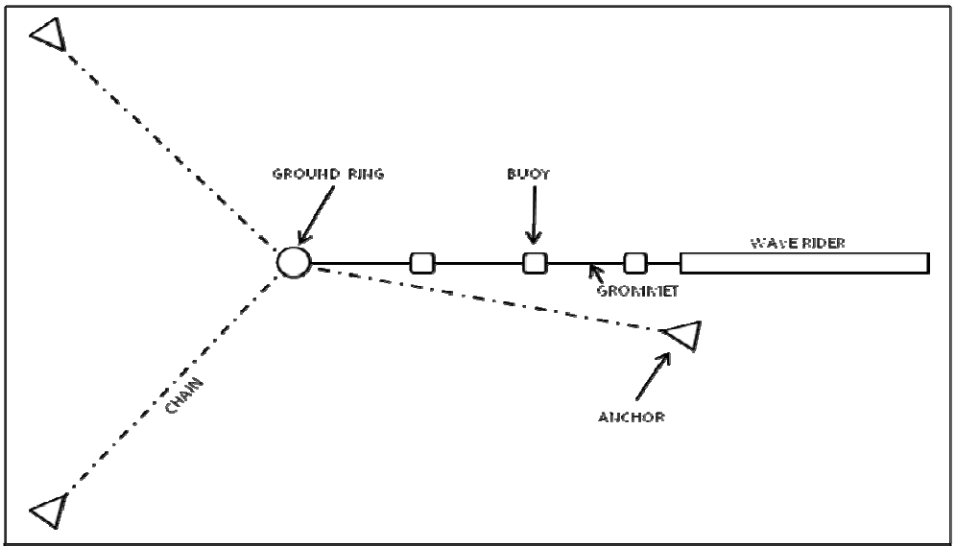

Figure 5: Wave Rider mooring concept design (not to scale).

2.3 Towing Phase

Towing the Wave Rider to Locks Well Beach will take approximately 5.5 days, depending on the weather conditions. All moving parts will be fixed ruing the towing phase.

2.3.1 Towing Arrangements

General arrangements of the tow assemblies can be found in drawing 2010-J085-020-B Towing Assemblies. Table 1 and

Table 2 show the components required during open water towing and emergency towing (respectively).

The system Minimum Breaking Load (MBL) will likely be governed by the breaking strength of the tow wire or the shackle connecting the tow wire to the buoy chain as the design load of the permanent mooring components is likely to be significantly greater than that assumed for the tow gear of the 60-tonne bollard pull tug assumed for the tow.

Table 1: Components required during open water towing.

Item	Description	Location	Length	MBL	No. of Items
1	105mm R5S Anchor type shackle	Tow bridle to device and triplate to hawser	NA	> 844 tonnes	5
2	105mm R3S grade studlink chain	Hawser to towing vessel	10m	966 tonnes	1
3	168mm Dia Nylon double braid grommet hawser	Triplate to studlink chain. Part of permanent mooring arrangement	100m	866 tonnes (Wet)	1
4	23” Hawser type shackle	Triplate to hawser and hawser to studlink chain	NA	1000 tonnes	2
5	SBP10 Anchor Pendant Buoy (Hawse Pipe Type)	Studlink chain passing through anchor pendant buoy	NA	NA	1
6	Triplate	Apex of tow bridle	NA	> 844 tonnes	1
7	103mm Six strand wire rope	Device to triplate(tow bridle)	20m	806 tonnes	2

Table 2: Components required during emergency towing.

Item	Description	Location	Length	MBL	No. of Items
2	Emergency Tow Bridle Triplate	Apex of tow bridle	NA	181 tonnes	1
3	55 tonnes WLL Green Pin Bow Shackles	Tow bridle to triplate and triplate to 85 tonnes shackle	NA	330 tonnes	3
4	85 tonnes WLL Green Pin Bow Shackles	55 tonnes shackle to tow pennant	NA	510 tonnes	2
5	56mm Gr1770 Wire Rope	Device to triplate (tow bridle)	10m	202 tonnes	2
6	88mm 12 strand Aquflex Grommet with hard eyes each end	Tow pennant/Stretcher	110m	252 tonnes	1
7	250 tonnes Green Pin Bow shackles	Emergency tow bridle to device connection	NA	1500 tonnes	2
8	3.25 tonnes Padeye	Securing/fastening system when emergency tow arrangement not in use	NA	NA	1
9	3.25 tonnes WLL Green Pin Shackle	Securing/fastening system when emergency tow arrangement not in use	NA	> 18 tonnes	1
10	3 tonnes Round Sling	Securing/fastening system when emergency tow arrangement not in use	1m	> 12 tonnes	1

2.3.2 Towing Routes

The proposed towing route from alongside the Land Management Corporation (LMC) Dock One to the mooring location southeast of Elliston, South Australia (Figure 6) is routinely used by other boats and ships, including fishing fleet vessels. Exact tow routing shall remain at the discretion of the tow master.

The total distance of the route described by the red line hereafter is approximately 490 kilometres, i.e. 264 nautical miles. This means that at a constant speed of 2 knots (Section 5.1.25.1.2 Required Bollard Pull), the total journey duration would be approximately 5.5 days.

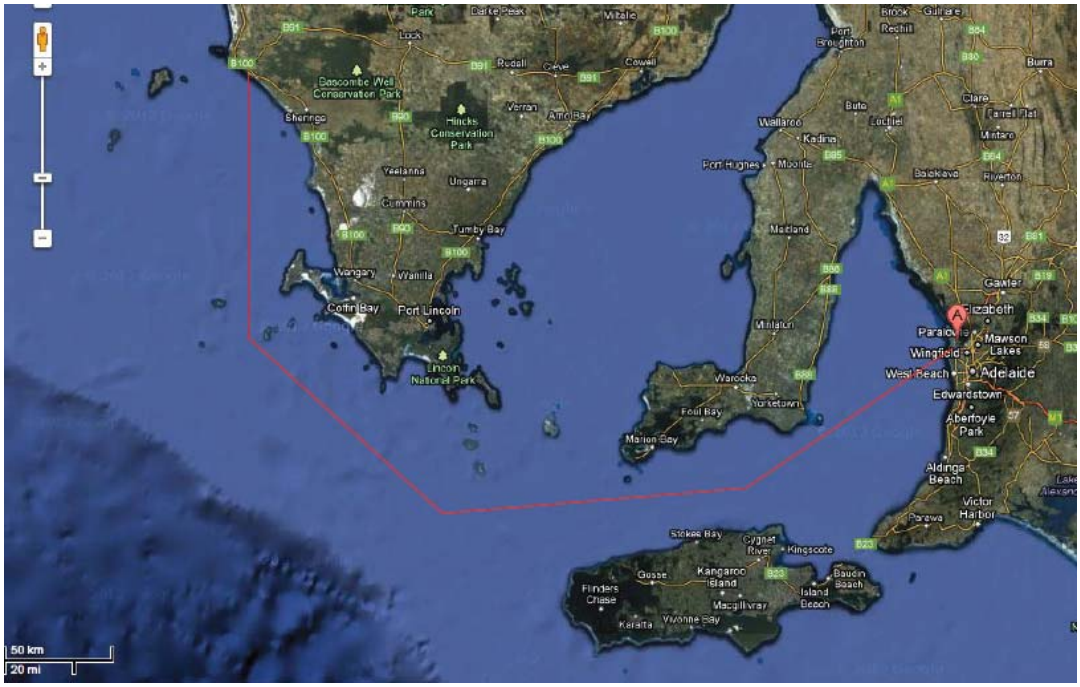

Figure 6: Map of proposed open water tow route.

The towing could be done during the first half of the month of May under the condition that the environmental conditions described in Section 5.1.1 are not exceeded.

Flexibility regarding the exact tow route is required to ensure the tow master is able to navigate safely and responsibly to climatic conditions. Varying weather conditions throughout the year means that there are limited opportunities to carry out the towing phase of the project. In addition to having predictably ideal climatic conditions, an environmental benefit of towing the Wave Rider during May is that there are fewer birds in the region at this time, hence minimising the risk of seabird collisions.

As the towing route is relatively long, it is necessary that emergency shelter areas of refuge are accessible within a few hours along the way due to predicted weather changes.

2.3.3 Tow Markings

Details of the lights and shapes to be displayed during the two in accordance with COLREGS (International Regulations for Preventing Collisions at Sea, 1972).

2.3.4 Stability Assessment

Stability assessments for the device have been prepared independently by Wave Rider Energy's Chinese Office. These have been approved by London Offshore Consultants (LOC) China.

3. INTERACTIONS BETWEEN THE WAVE RIDER AND THE MARINE ENVIRONMENT

A risk assessment workshop was undertaken by personnel from South Australian Research and Development Institute (Aquatic Sciences), Wallbridge & Gilbert and Wave Rider Energy and was used to assess the potential interactions between the project and the marine environment, including during the towing phase of the project. Management measures have been suggested to mitigate identified risks where possible.

3.1 Physical Damage to Marine Flora

Physical damage to marine flora was identified as a potential effect of the towing phase of the project. Physical damage from collision with protrusions below the water has the potential to cause reduced vigour and death to seagrasses and seaweeds.

The risk associated with physical damage to marine flora during towing was identified as negligible risk (rare likelihood, insignificant consequence) given:

- Established shipping routes will be utilised between Port Adelaide and Locks Well Beach
- The Wave Rider is only 4 metres in height and floats on the surface.

3.2 Injury and Death of Seabirds and Marine Mammals from Collisions

Collision with protrusions above and below the water and with tow lines causing seabird and marine mammal injury and death were considered effects of the towing phase of the project and are presented in Table 3 along with the level of risk identified for each effect.

Table 3: Risk assessment of the potential for seabird and marine mammal injury and death from collisions during towing.

Effect	Fauna	Likelihood	Consequence	Risk
Injury and death from collision with protrusions above water	Seabirds	Possible	Minor	Low
	Marine Mammals	Rare	Minor	Low
Injury and death from collision with protrusions below water	Seabirds	Rare	Minor	Low
	Marine mammals	Rare	Minor	Low
Injury and death from collision with tow lines	Seabirds	Possible	Minor	Low
	Marine mammals	Rare	Minor	Low

The likelihood of seabirds colliding with parts of the Wave Rider or tow lines during towing is considered relatively high. However, because the towing phase is expected to take 5.5 days, the severity of these consequences is regarded as minor and would not cause a decline in a subpopulation that could not be recovered.

To reduce seabird collisions, devices that alert birds (audibly and visually) to the presence of obstructions such as bird flight diverters, tori lines, bright coloured paint, flags and lights will be incorporated on the Wave Rider. Towing the Wave Rider at a time when fewer birds are in the region (May to September) could further minimise the incidence of seabird collisions. The incidence of seabird and marine mammal collisions during towing will be monitored during daylight hours of the towing phase.

3.3 Transfer of Introduced Pest Species

The transfer of introduced pest species between Port Adelaide and Locks Well Beach could potentially harm the marine environment through the disruption of ecological systems. Port Adelaide is situated within an Interim Marine and Coastal Regionalisation for Australia (IMCRA) region with marginally more introduced pest species than the IMCRA region for Locks Well Beach (National Oceans Office 2010).

A contentious pest species is the alga *Caulerpa taxifolia* which has formed invasive populations outside its native range and can form large monospecific stands that can smother competitors and offer little compensation as a food source. In South Australia, the distribution of *Caulerpa taxifolia* is restricted to the Port River – Barker Inlet and Bolivar system (Wiltshire and Rowling 2009).

The transfer of introduced pest species between Port Adelaide and Locks Well Beach is considered low risk (unlikely, minor consequence) given:

- The Wave Rider will be moored at Port Adelaide for a short period of time preventing settlement or recruitment of marine organisms

- The Wave Rider will receive an environmentally friendly antifouling surface treatment to protect it from corrosion and barnacles.

To eliminate the risk the Wave Rider should be inspected prior to deployment from Port Adelaide.

4. MANAGEMENT AND MITIGATION MEASURES

Based on the environmental risk assessment the following management measures have been suggested to mitigate risks identified for the towing phase of the project:

- Inspecting the Wave Rider prior to deployment from Port Adelaide to further reduce any incidences of pest introduced species movement
- The Wave Rider will receive an environmentally friendly antifouling surface treatment to protect it from corrosion and barnacles
- Towing the Wave Rider at a time when fewer birds are in the region (May to September) to further minimise the incidence of seabird collisions
- Using devices that alert birds (audibly and visually) to the presence of obstructions such as bird flight diverters, tori lines, bright coloured paint, flags and lights, in order to reduce the risk of seabird collisions
- Monitoring the incidence of litter accumulation in the truss structure throughout the pilot to best understand the implications
- Using noise loggers during operations to better quantify ongoing noise disturbance to any calving whales.

Although not relevant to the risk assessment process, seals have the potential to negatively affect the operations of the Wave Rider. For both ecological and operational efficiency reasons, the design of the cross beams will be modified to provide a steep curved surface which may prove difficult for seals to haul out. Interactions between the Wave Rider and seals will be carefully monitored during the pilot study.

In addition, the effects of the Wave Rider structure on fish schooling and the interaction with higher predators will be monitored throughout the pilot utilising a video camera installed on the Wave Rider and by periodic inspections. A trained ornithologist will be on board to conduct surveys during the hours of dawn, midday and dusk each day. If necessary, the towing times will be modified to avoid periods of the day in which a significant number of collisions are occurring.

4.1 Summary

As discussed, the Wave Rider project presents only a low risk in terms of the effects of interactions with the environment. However, Wave Rider Energy has developed management and mitigation measures to control all identified risks. In summary, these include:

1. Constantly monitoring and inspecting interactions with the environment
2. Using devices to alert birds as a control mechanism
3. Using an environmentally friendly antifouling surface treatment to reduce the risk of introduced pest species
4. Using flexible towing times in order to minimise identified risks
5. Ensuring an ornithologist is on board to record potential interactions and determine the times during which minimal collisions will occur
6. Adapting management plans to account for unexpected identified environmental risks

Should any unexpected environmental risks be recognised, Wave Rider Energy will act accordingly to mitigate these. Depending on the severity, this may mean the towing of the Wave Rider will be forced to an emergency stop until rectification methods are implemented.

The towing phase of the project is essentially a similar exercise to operating a boat using the open water. Furthermore, the proposed towing route is frequently used by other boats and ships and hence the towing of the Wave Rider should be treated in a similar manner.

5. TOW ANALYSIS

The Wave Rider has been investigated in open water and emergency tow conditions in order to size the respective towing assemblies. This section summarises the analysis.

5.1 Open Water Tow

5.1.1 Metocean Conditions

The primary towing gear forms part of the permanent mooring assembly which has been designed to endure the 20-year return condition at the installation site. The 20-year design conditions are detailed below:

- Surface current: 1 m/s
- Significant wave height: 8.5 m
- Maximum wave height: 17 m (approximately)
- Wave period: 17.5 s
- One hour wind speed: Neglected due to very low freeboard of device (around 1 m)

It should be underlined that, under no circumstances, is the tow expected to occur in such conditions. These are given above to document the design criteria for the permanent mooring components used in the tow.

5.1.2 Required Bollard Pull

The peak mooring load was estimated to be approximately 415 tonnes as documented in 2010.j085.002.0. This represents the design load of the mooring components used in the tow with the minimum factor of safety achieved being 2.0.

As such the MBL of the towing arrangement will likely be well in excess of the requirements of the applicable guidelines.

The towing analysis conducted indicated that in order to meet the recommended minimum tow speed of 5 knots, a 300 tonne bollard pull tug would be required. This is impractical given the available vessels.

A vessel with a bollard pull of 60 tonnes has therefore been assumed which, based on the analysis, is likely to be able to make 2 knots forward progress in the conditions proscribed.

5.2 Emergency Tow

5.2.1 Metocean Conditions

The emergency towing gear is intended for use only in the event of a failure in the primary towing assembly. The assumed conditions in sizing the assembly are described below:

- Surface current: 0.5 m/s
- Significant wave height: 5.0 m
- Wind speed: Neglected due to very low freeboard of device (around 1 m)

5.2.2 Required Bollard Pull

The mean towing load was estimated to be approximately 31 tonnes.

A vessel with a bollard pull of 60 tonnes has therefore been assumed in sizing the emergency towing assembly.

6. TOWING PROCEDURES

This section provides a summary of the towing procedures that have been developed by AMOG. The procedures discussed include pre sail-away checks for open water tow, connection of hawser grommet during tow, emergency disconnection of tow assembly and connection of emergency tow assembly.

All participants in the operation, including third party contractors, quayside banskmen, etc. shall attend a tool box meeting to ensure a proper understanding of the processes to be undertaken, the PPE that is required and the chain of command for the works.

While carrying out procedures, deck crew shall be mindful of the risk of crush injuries during the handling of chains and towing components, as the disconnection of lines under tension presents considerable risk of backlash which may result in injury or death. During the over boarding of the connection, deck crew shall ensure that they are clear of the path of the assemblies. Warnings shall precede winch operations in order to alert deck crew. All rigging used during the load out shall have current certification.

Reference Documents:	2010-J085-210-002	Hawser
	2010-J085-210-020-B	Towing Assemblies

6.1 Pre Sail-Away Checks – Open Water Tow

A number of actions to be confirmed prior to towing the device from LMC Dock One to the mooring location have been developed (detailed in Box 1). The actions relate to ensuring all connections of the Wave Rider are adequate, emergency tow components are securely attached, operating devices are functioning, and all required equipment is available on board.

Box 1: Pre-sail away detailed procedure.

1. *The primary and emergency tow assemblies are correctly connected with, and all shackles are secured and split pins inserted.*
2. *The shackle connections between the emergency tow bridle and the shackle on the main device pad eyes are held clear of the primary tow assembly.*
3. *The emergency tow bridle is securely fastened to the forward pontoon, clear of the primary tow assembly.*
4. *The emergency tow line is securely lashed along the length of the device, clear of the waterline.*
5. *The emergency tow assembly pick up line is securely attached and free to stream untangled astern of the device.*
6. *The correct tow markings have been placed on the device.*
7. *All navigation lights are operational and their batteries fully charged.*
8. *The snotting chains required to effect the connection of the permanent mooring hawser grommet once the device has been towed to deep water are aboard the tow vessel.*
9. *There are no loose materials.*

6.2 Connection of Hawser Grommet During Tow

The Wave Rider will transit the Adelaide River during its tow from LMC Dock One to the mooring location. The water depth of the river is significantly less than the effective length of the permanent mooring bridle at approximately 9.3 metres. In the event of the tow assembly becoming slack, the triplate and the hawser grommet connected to it may sink to the river bed, with the attendant risk of entanglement. To protect the hawser from this event, the Wave Rider shall be towed to deeper water without the hawser grommet in the tow assembly.

Box 2 details the procedure to safely disconnect the tow line from the triplate and insert the hawser grommet into the towing assembly, assuming the tow vessel's stern is enclosed and therefore the hawser buoy must be kept afloat during the initial tow and transfer.

Box 2: Detailed procedure for connecting hawser grommet during tow.

1. *Alongside the quay, muster and check equipment, and moor the primary tow vessel.*
2. *Arrange fenders at the far stern quarter to protect the hawser buoy during tow.*
3. *Pass the buoy chain through the hawse pipe, secure the chain plates and connect the chain to the hawser.*
4. *Connect crane to buoy chain and attach tag lines as required.*
5. *Lift buoy and hawser grommet over stern of primary tow vessel.*
6. *Set base of hawser buoy in water and secure the hawser grommet on deck before horizontally laying down the buoy.*
7. *Lower buoy chain down onto the deck of the primary tow vessel and secure.*
8. *Disconnect crane.*
9. *Check that the buoy chain and hawser grommet connection is secure.*
10. *Lift remaining hawser grommet aboard the primary tow vessel using crane.*
11. *Fake out hawser grommet on deck.*
12. *Conduct tow of the device, with the primary tow vessel connected to the permanent mooring bridle.*
13. *On reaching open water with a depth greater than 40 metres, commence change over operations.*
14. *Recover permanent mooring triplate to the deck of the primary tow vessel.*
15. *Pass snotting chain bight through bow of anchor shackle on triplate and secure on deck over karm fork.*
16. *Release tension from tow wire and confirm all secure before disconnecting it from anchor shackle on triplate.*
17. *Using a hawser type shackle, connect the triplate anchor shackle to the hawser.*
18. *Photograph assembly.*
19. *Connect the tow wire to the buoy chain.*
20. *Remove any additional lines securing the buoy and clear the deck.*
21. *Retract karm fork and release permanent mooring bridle.*
22. *Transit forward, allowing the hawser grommet to run from deck, ensuring it is kept clear of stern gear.*
23. *As limit of hawser grommet is reached pay out tow wire, ensuring the hawser buoy moves around the stern quarter of the primary tow vessel.*

6.3 Emergency Disconnection of Tow Assembly

A simple procedure has been established for the emergency disconnection of the tow assembly. Firstly, the tow wire is to be recovered until the buoy chain is brought aboard. The buoy chain is then to be captured in the karm fork. If the karm fork is not available, a snotting chain bight is to be passed through the buoy chain common link and secured on deck over a pelican hook. The tow wire at the shackle connecting the end link of the buoy chain to the tow wire is to be disconnected. When the vessel master confirms they are ready to release the device, the deck is to be cleared before retracting the karm fork or releasing the pelican hook and buoy chain.

6.4 Connection of Emergency Tow Assembly

AMOG has developed a procedure for the pick-up and connection of the emergency tow assembly (detailed in Box 3). This procedure presents a list of steps explaining how to position, connect and disconnect appropriate components in order to adequately connect the emergency tow assembly.

Box 3: Detailed procedure for connecting emergency tow assembly.

1. *Position stern of tow vessel adjacent to trailing pick-up line of emergency tow assembly, ensuring it is kept clear of stern gear.*
2. *Using a grappling hook, recover the pick-up line to deck and connect to a deck tugger.*
3. *Clear the deck prior to pulling the emergency tow pennant free.*
4. *Using the tugger, pull free the emergency tow pennant from the lashings, securing it to the side of the device.*
5. *Pull free enough pennant to allow safe recovery of the termination to deck.*
6. *Choke soft sling around pennant behind hawser thimble and secure over karm fork.*
7. *Disconnect pick-up line.*
8. *Using an appropriate shackle, connect vessel tow line to end of emergency pennant.*
9. *Take tension from soft sling and disconnect.*
10. *Stand vessel off as required and release any length of pennant still attached to device, pulling the triplate free from its mount on the forward pontoon.*

7. SAFETY AND ENVIRONMENTAL PROTECTION

Safety and the preservation of the environment are of paramount importance throughout all scopes of work. All works shall be carried out in accordance with the project specific documentation and the approved, detailed work procedures.

A preliminary Hazard Identification Study (HazID) shall be undertaken onshore where the whole work scope will be discussed. Safety issues resulting from this HazID shall be documented in a JSA and be considered in the development of this procedure.

A list of specific safety concerns/issues is presented below. Toolbox Meetings shall be conducted prior to any work commencing and at any change of shift. Issues arising shall be incorporated, as appropriate, into the JSA/JHA and where such issues require, this procedure shall be amended accordingly. Should any onboard safety assessment highlight major unanticipated safety risks, work shall be postponed pending a review of the procedure, addressing the safety concerns.

Any changes to the procedure should be subject to an offshore Hazard and Operability Study (HazOP). Members of the project team and the onboard project engineer shall assess/establish a different method of addressing the safety concerns raised. This shall be communicated to and/or discussed with the onshore project management team prior to work continuing.

Any personnel witnessing an act which they believe to be unsafe or damaging to the environment shall be duty bound to stop that act in a safe manner, pending investigation or explanation.

Throughout the works, the following generic risks have been flagged. Operational crew shall be mindful of their continuous presence.

Lines under tension:	Throughout the tow, tensioned lines will be present on deck. These represent a lethal hazard in the unlikely event of failure. Personnel shall ensure that they do not position themselves near such lines in accordance with the tow contractors' standard operating procedures.
Open deck:	Crew working on the deck of vessels near open sterns shall wear a personal floatation device.
Shifting loads:	Tow line components may shift on the deck of the vessel during normal operation. Crew shall be mindful of this during all activities.
Operating machinery:	The operation of winches and other equipment presents jamming and crushing hazards to operations personnel. Suitable guards shall be fitted to mitigate this risk. Machinery shall only be operated by appropriately trained personnel.
Communications:	Clear instructions are to be given and followed. An understanding of the instruction shall be communicated prior to action being taken on the instruction.

8. CONCLUSION

The Wave Rider project presents an opportunity to encourage the use of renewable energy in Australia. The innovative technology, which has been proposed by Wave Rider Energy to be moored for a period of 18 months in Locks Well Beach, operates by converting wave energy to electrical energy.

The Government of South Australia and associated Departments have approved the project in terms of its environmental impact, and the intention of this document is to comply and facilitate authorisation from the Department of Sustainability, Environment, Water, Population and Communities to commence the project.

This document is concerned with the towing phase, which is the initial stage of the project. The towing arrangements, proposed route and towing procedures have been discussed. A tow analysis is also included.

The towing procedures presented relate to the preparations to be undertaken prior to a tow, principal towing arrangements, emergency towing arrangements and procedures for their use, as well as emergency disconnection of towing gear.

The Wave Rider has been previously assessed in terms of its environmental impact, and AMOG have developed management and mitigation measures accordingly. As the Wave Rider is to operate as a pilot, Wave Rider Energy is committed to monitoring and documenting the interactions of this new technology with the surrounding environment, through well-developed and comprehensive adaptive management and monitoring programs.

The nature of the project means that there are limited opportunities throughout the year to commence operations and perform the towing phase. The month of May is ideal due to the predicted climatic conditions, combined with the environmental benefit of there being fewer seabirds in the region at this time, hence minimising the risk of seabird collisions.

In its simplest form, the Wave Rider can be considered as an open trussed structure that will be moored for up to 18 months, collecting data to facilitate the improvement and existence of revolutionary technology used to convert wave energy into electrical energy.

9. REFERENCES

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