NOTICE OF INTENT

Clarence Strait Tidal Energy Project, Northern Territory

Prepared for

Tenax Energy

GPO Box 2848
Darwin NT 0801

17 December 2008

42213817

Project Manager:

Shelley Franklyn
Environmental Scientist
URS

URS Australia Pty Ltd

Level 3, 93 Mitchell Street
Darwin, NT 0801
GPO Box 2005, Darwin NT 0801
Australia
Tel: 61 8 8980 2900
Fax: 61 8 8941 3920

Project Director:

Ian Hollingsworth
Principal Environmental Scientist
URS

Author:

Shelley Franklyn
Environmental Scientist
URS

Date: 17 December 2008
Reference: Notice of Intent, Tidal Power Generator, Clarence Strait, Northern Territory
Status: FINAL

Proponent:

Alan Major
Managing Director
Tenax Energy

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**Note: Figure 3-1 Location of Generator Site is attached.

Introduction Section 1

This report has been prepared by URS Australia Pty Ltd (URS) on behalf of the proponent Tenax Energy Pty Ltd (Tenax Energy) to provide a formal Notice of Intent (NOI) for assessment under the *Environmental Assessment Act 1982* of the proposal to install a tidal energy generation project within Clarence Strait, north east of Darwin, Northern Territory.

The Clarence Strait Tidal Energy Project will include approximately 456 tidal energy generators being installed on the sea floor of Clarence Strait and associated submarine cables, switching gear, transformer, substation, and powerlines to provide a connection to the Darwin/Katherine grid.

This NOI will provide an outline of the project and information required under the Environmental Assessment Administrative Procedures 1984,.

Tenax Energy is a company that is committed to exploring, developing and bringing to market the most reliable and efficient renewable energy technologies available. Tenax Energy is focussed on meeting rising energy demands in a cost-effective manner while maintaining a focus of reducing greenhouse gas emissions.

Tenax Energy has investigated tidal resources at various sites around Australia and found that there are limited areas that have the necessary tidal velocities to generate electricity utilising current technology. One of these sites is Clarence Strait, Northern Territory.

Tidal energy is a clean renewable energy source that has the advantage over other forms of renewable energy such as wind, solar and wave energy generation of being highly predictable and reliable. The times at which the generators can operate (around 70% of the time in Clarence Strait) can be forecast with exceptional accuracy, years in advance. Investing in this type of power generating technology has the security of a pre-defined electricity output during the life of the asset, offering both realisable and sustained benefits to the local community.

This highly reliable form of renewable energy generates power without producing greenhouse gases, and has a nominal environmental impact. Recent technological improvements have significantly increased the generating capability, and reduced the capital cost of this energy source. These developments have encouraged the planning of new tidal generation projects in New Zealand, Korea, Canada, USA and the United Kingdom.

Section 2 Project Background

2.1 Name and Contact Details of Person Lodging the Application

This application is being lodged by:

URS Australia Pty Ltd

Level 3, Mitchell Street

Darwin, NT, 0801

Contact: Ian Hollingsworth

Phone: (08) 8980 2900

Email: ian_hollingsworth@urscorp.com

2.2 Proponent

Company: Tenax Energy

Contact: Alan Major

Address: GPO Box 2848, Darwin NT 0801

Phone: (08) 8941 7688

Tenax Energy Pty Ltd (Tenax Energy) is a proprietary limited company registered on 16/08/2007.

2.3 Project Name and Location

2.3.1 Project Name

The project is known as the Clarence Strait Tidal Energy Project.

2.3.2 Project Location

Name: Clarence Strait

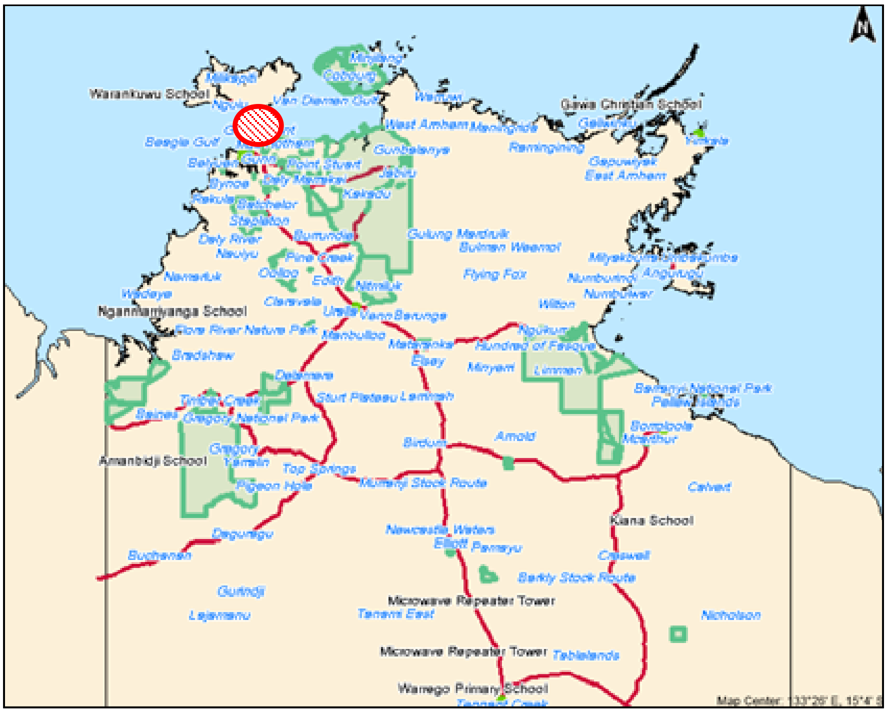
Location: Clarence Strait, North East of Darwin, Northern Territory (NT), Australia. Refer to Figure 2-1 for map of location.

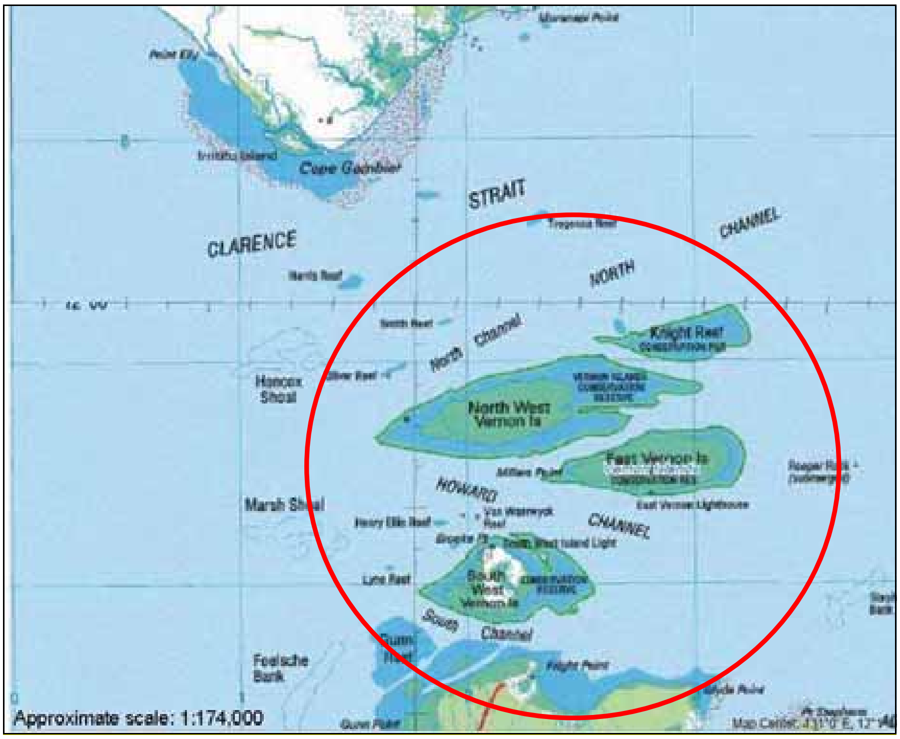
The Clarence Strait Tidal Energy Project has offshore and onshore components. The offshore part of the project is located in Clarence Strait, a significant tidal resource, in the vicinity of Glyde Point in Northern Territory waters. The onshore part of the project is a linear alignment located between a point north west of Glyde Point and the northern most extent of the proposed infrastructure corridor associated with the recently deferred Glyde Point industrial development, Section 2626 in the Hundred of Bagot, Municipality of Litchfield.

Clarence Strait is a narrow body of water in the vicinity of the Vernon Islands, approximately 50 km north of Darwin, Northern Territory and south of Melville Island, Tiwi Islands. It links the Beagle Gulf in the west with the Van Diemen Gulf in the east. Figure 2-1 shows the general location of Clarence Strait in relation to the Tiwi Islands, Vernon Islands and the Northern Territory mainland.

Figure 2-1 Location of Clarence Strait, Northern Territory

(Source: N.T. Land Information System, NRETA maps)





Section 2 Project Background

2.4 Policy Support

Demand for energy in Australia is projected to increase by 50% by 2020, and the energy industry has estimated that at least $37 billion in energy investments will be required by 2020 to meet the nation's energy needs. Meeting this increased demand for energy, while moving to a low-emissions future, is a key challenge facing Australia's future growth and living standards. Electricity generation is a major primary energy user, equal to around 40%of total primary energy (Department Prime Minister and Cabinet, 2004).

The Mandatory Renewable Energy Target (MRET) originated as part of the Prime Minister's *Safeguarding the Future: Australia's Response to Climate Change*, announced in November 1997. MRET placed a legal liability on wholesale purchasers of electricity to proportionately contribute towards the generation of an additional 9,500 GWh of renewable energy annually by 2010, and is to be expanded to source at least 20% of Australia's electricity supply, the equivalent of an additional 60,000 GWh generated from renewable sources by 2020.

The Clean Energy Council has estimated that the revised Renewable Energy Target will generate 50,000 new jobs and $20 billion in investment in the renewable energy sector.

Therefore, the development of sustainable and economically viable means of producing energy is essential to preserving the standard of living of the population, and meeting the energy policies of the State and Commonwealth Governments.

2.4.1 Power generation and consumption in the NT

Consumption and peak demand for electricity are forecast to increase by an average of 3% per annum (baseline growth) in the Darwin - Katherine region (Utilities Commission, 2006), plus additional demand being created by new resource projects.

It is likely that Power and Water Corporation (Power and Water) is the only party actively planning to invest in new capacity for power generation. In their *Environment Report 2007*, Power and Water indicate that they "will most likely be unable to meet our future MRET (Mandated Renewable Energy Target) obligations from existing sources and will need to develop additional sources of RECs (Renewable Energy Certificates)". According to the NT Utilities Commission (UC), the Territory's power market is open to investment from any source that meets the licence criteria (Utilities Commission, 2007). The UC predict, based on the N2 reserve standard (which indicates the generation capacity excluding the two largest generating sets in a particular system), that additional power generation capacity will be required in the NT by 2008-2009 (Utilities Commission, 2006).

Power and Water currently has power purchase agreements with three Independent Power Producers (IPP's); Energy Developments Ltd's subsidiary NGD (NT) Pty Ltd (Pine Creek Power), Landfill Management Services Pty Ltd (LMS Shoal Bay) and Central Energy Power Pty Ltd (Brewer) (Utilities Commission, 2007). Overall, about 44 MW of capacity is currently available from these IPP's (UC, 2007).

Once the project is fully developed, the energy output is expected to be a considerable contributor to the energy currently generated in Darwin. So as to not overload the Darwin/Katherine electricity grid with the increased capacity, the project site will be developed in several stages. It is noted that with the future population growth and the development of gas and other industries in Darwin, this will satisfy the increase in electricity production.

3.1 Requirements

Tenax Energy engaged Kellogg Brown & Root to re-instate the hydrodynamic modelling of Clarence Strait undertaken as part of the recently deferred development of Glyde Point (by the NT Government),to identify sites suitable for development of tidal power generators, based on the following two main criteria:

- reliable and consistent tidal currents, with velocities of above 2.0 m/sec for extended periods and flows that reverse in direction at 180 degrees with the change in tides, and
- proximity to existing electricity transmission infrastructure, to reduce power transmission and storage losses.

Water depth is another critical factor, with a minimum of 20m required for a Tidal Energy Generator (TEG) Unit. Deeper water allows higher MW rated units, and current velocities are impaired close to the bottom of the flow column.

3.1.1 Clarence Strait site

Clarence Strait is a narrow body of water in the vicinity of the Vernon Islands, approximately 50 km north of Darwin, Northern Territory and south of Melville Island, Tiwi Islands. It links the Beagle Gulf in the west with the Van Diemen Gulf in the east. The Strait is situated within the Timor Sea with the Vernon Islands located within the Strait. The islands consist of North West Vernon, South West Vernon and East Vernon Island and Knight Reef. These islands form three channels that wind through the area. These are generally 100 m to over 1 km wide and have complex bathymetry.

The proposed Clarence Strait site was identified as the site with the greatest tide velocities in the greater Darwin vicinity. Clarence Strait experiences tidal variations of up to 5 m, producing extended periods of suitable tidal currents. The water depth in Clarence Strait varies from 25 to 50 m based on Australia Hydrographic Charts of the area (adequate depth for TEG) and the velocity ranges from 2.00 to 2.75 m/s.

Power generation is to be established in the strong currents that exist within the channels in the Clarence Strait.

Electricity will be brought ashore to connect to the proposed infrastructure corridor associated with the deferred Glyde Point development site.

Figure 3-1 *Location of Generator Site* (attached) presents the location of the selected site.

3.2 Description of Preferred Area

3.2.1 Turbine Area

The areas with high velocities and sufficient depth in Clarence Strait are large. Therefore, the energy generation potential (Mwh/m^2/year) is comparably high. Electricity will be generated for 68% of the time – nearly 17 hours each day.

The size of the preferred turbine area is approximately 1691 ha (refer to Figure 3-1 *Location of Generator Site* attached).

Table 3-1 Coordinates of turbine sub-areas

Location reference	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
Turbine sub-area 1	131	1	48	-12	1	1
	131	2	10	-12	1	3
	131	2	31	-12	1	0
	131	3	11	-12	0	31
	131	3	22	-11	59	52
	131	2	56	-11	59	28
	131	1	52	-11	59	52
	131	1	44	-12	0	17
	131	2	2	-12	0	46
	131	1	34	-12	0	57
	131	0	50	-12	1	30
	131	0	18	-12	1	40
	131	0	18	-12	1	52
	131	0	54	-12	1	33
	131	1	16	-12	1	36
	131	1	37	-12	1	30
	131	1	55	-12	1	20
	131	2	28	-11	59	39
Turbine sub-area 2	131	1	26	-12	4	1
	131	2	31	-12	4	13
	131	2	35	-12	4	21
	131	2	17	-12	4	31
	131	1	41	-12	4	37
	131	1	1	-12	4	42
	131	0	43	-12	4	26
	131	0	47	-12	4	12
	131	1	1	-12	4	9
Turbine sub-area 3	131	2	46	-12	5	24
	131	2	13	-12	4	36
	131	1	12	-12	4	49
	131	1	30	-12	5	14
	131	0	43	-12	5	32
	131	0	29	-12	5	37
	130	59	49	-12	5	52
	130	59	53	-12	5	53
	131	4	19	-12	5	44
Turbine sub-area 4	131	3	25	-12	7	58
	131	3	50	-12	8	7
	131	4	8	-12	7	52

	131	3	11	-12	7	45
	131	3	4	-12	7	32
	131	3	40	-12	7	46
	131	3	36	-12	7	27
	131	4	12	-12	7	19
Turbine sub-area 5	131	4	44	-12	7	48
	131	5	10	-12	7	59
	131	5	28	-12	7	50
	131	5	10	-12	7	48
	131	4	59	-12	7	53
	131	4	48	-12	7	49
	131	4	23	-12	7	56

3.2.2 Submarine Cable Area

The project proposes five locations linked by a series of submarine cables (in total 23 km) to a junction point. A 5.8 km cable links the junction point to the proposed Glyde Point infrastructure corridor. The area of the cable is approximately 2.3 ha.

The submarine cable route will generally be in line with the coordinates outlined in Table 3-2.

Table 3-2 Coordinates of cable corridor

Cable reference	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
A	131	0	18	-12	1	48
AB	130	58	16	-12	3	37
B	131	0	43	-12	4	21
C	131	3	32	-12	4	40
C	131	2	35	-12	4	21
F	131	4	26	-12	7	52
E	131	5	13	-12	5	50
EFG	131	5	46	-12	7	52
D	131	3	4	-12	7	54
D	131	2	46	-12	7	58
G	131	6	32	-12	10	14

3.2.3 Shore Crossing

The submarine cable will be Horizontal Directionally Drilled (HDD) under the coastline, to minimise impacts on coastal and dune areas. The HDD component of the cable will be approximately 2 km in length, however the length of cable installed by HDD can be extended if further environmentally sensitive areas are identified.

3.3 Jurisdiction

The proposed development area of the tidal energy project is located within Northern Territory waters and within the Municipality of Litchfield. Although Northern Territory legislation applies to the project area, there is also Commonwealth legislation that will apply to the project as well, notably the EPBC Act.

The Clarence Strait Tidal Energy Project will involve the installation of up to 456 turbines on the seafloor. The turbines contain a rotor of 15 m diameter contained within an outer rim which contains a generator. Ocean currents and tides cause the rotor to spin. The rotating turbines generate electricity whenever the tide flows (in-coming and out-going), which makes this form of renewable power extremely reliable.

4.1 Background to Tidal Energy Generation

The utilisation of the cyclical movement of water known as tides to generate power has been studied for centuries. Twice a day, the water level of the sea rises and falls in response to the tidal influences of the sun and moon creating powerful and reliable water currents.

The future capability of tidal generators is predictable with a high degree of accuracy many years in advance. Tidal generators therefore offer electricity suppliers certainty and allow the scheduling of tidal power with back-up sources well in advance of requirements. The predictability offered by tidal power generation is greater than other renewable power sources such as solar, wind and wave generation, which are not predictable (as they are dependent on the weather).

Until recently, the main way of utilising tidal power has been through the use of Barrage Tidal Power Generation Systems. However, recent technological advancements have advanced an alternative method known as Tidal Stream Systems (such as the type proposed for this project).

4.1.1 Tidal energy applications worldwide

The concept of harnessing tidal energy to produce electricity was first investigated by Reading University in the UK in 1979, and by Davis in Canada and Hilton in Australia at about the same time (Kirke, 2003). It was also used in Africa on a small scale in the early 1980’s to extract energy from river currents.

The preferred TEG technology proposed for installation by Tenax Energy at Clarence Strait are similar to those designed by OpenHydro, Ireland and Clean Current Power Systems, Canada. OpenHydro installed the first grid-connected facility based on this technology at the European Marine Energy Centre (EMEC) in Orkney, north of Scotland, in 2006, whilst Clean Current installed their TEG in the Race Rocks Ecological Reserve, British Columbia, during 2006 to replace the traditional power generation systems on the Island. Both open-centre turbine designs were among the first tidal technologies in the world to reach the stage of permanent deployment at sea.

The idea of using current flow on a large scale is relatively new, and of particular interest is Crest Energy Limited’s (Crest Energy) proposed development of a major tidal power facility in northern New Zealand. The project comprises up to 200 completely submerged TEGs with a maximum generating capacity of around 200 Mw, located near the entrance of Kaipara Harbour in Northland (Crest Energy, 2007). The TEGs involved are of a similar design to those proposed by Tenax Energy.

Argo Environmental Limited (Argo) conducted assessments of the potential environmental impacts of Crest Energy’s project and found that the tidal power facility could provide “significant (power) generation without over-riding adverse environmental effects and associated concerns” (Argo, 2006). Crest Energy and the New Zealand Government are currently in the advanced stages of environmental impact assessment for the project, with resource consents recently granted by the Northland Regional Council’s hearing committee (Crest Energy, 2007; The National Business Review, 2008).

4.2 Tidal Stream Systems

Generating electricity directly from the kinetic energy of tidal water movement, also known as Tidal Stream Systems, is a relatively new technology that has been advancing of late by becoming more efficient and practical for large scale use. The electricity generation process works by converting the kinetic energy of moving water directly to mechanical shaft power, without otherwise interrupting the natural water flow. This process is similar to the way that the now common wind turbines work. Although Tidal Stream Systems generally harness less of the total available energy from a tidal flow in an estuary or strait than a Barrage installation would, Tidal Stream Systems have the following advantages over Barrage Systems:

- can be located in open water environments
- the capital costs of civil works associated with a dam construction are eliminated
- disruption to boating and ecosystems is minimised, and
- in addition to tidal flows, ocean currents, wind-induced currents and river flows can be used.

As there is no requirement for Tidal Stream Systems to be located in areas with a large tidal rise and fall, a wider range of sites are potentially suitable. A key selection criterion is the presence of suitable water currents for energy conversion. Therefore, a wider range of sites can be utilised, including harbour entrances, straits between islands or headlands and any other sites where there is frequent or consistently strong water flow.

There are however, some potential problems associated with Tidal Stream Systems, including:

- very large downstream drag forces, several times larger than those acting on a wind turbine of similar power output, requiring strong anchorage
- weed growth on blades, which could reduce efficiency
- corrosion, and
- storm damage.

Recent marine turbine design innovations have to a certain extent mitigated potential problems associated with Tidal Stream Systems. These innovations, combined with stringent operating and maintenance procedures, lessen the limitations and extend the life of the assets.

4.3 Science of Tidal Energy Generation

Marine turbines are designed to catch water currents; in much the same way as a windmill catches the breeze. The movement of water causes the blades to spin. The motion (water current) represents energy and that energy can then be used or converted into other forms of energy. The following equation indicates the variables that determine the amount of power that can be produced by marine current turbines.

$$\textbf{Power} = \pi/8 * d\mathrm{D}^2 v^3$$

(where *d* = density of seawater; D = Turbine Diameter; and *v* = velocity of water currents)

Note: If *d* and D are measured in metres and *v* is measured in metres per second then power is measured in watts.

As the density of sea water (*d*) is easily measurable with only minor variations, the only variables that would influence the amount of power available for electricity are:

- the diameter of the turbine blades (D), and
- the velocity of the water currents (*v*).

The equation demonstrates the total output of power is directly proportional to the cube of the velocity of the water current. This means that a small increase in water current velocity can produce a large increase in power. For example, if water current velocity is 2 km/h, the value of v^3 would be 16. However, if water current velocity is doubled to 4 km/h, the value of v^3 would be 64. Therefore, a doubling of the water current velocity would lead to a four-fold increase in power output.

Similarly, the equation indicates the total output of power is directly proportional to the square of the turbine diameter. This means that the length of the rotor blades is an important determinant in the total amount of power produced. For example, if the turbine diameter is 10 m, then the value of D^2 would be 100. However, if the turbine diameter is doubled to 20 ms, then the value of D^2 would be 400. Therefore, doubling the diameter of the turbine (rotor blade length) produces a four-fold increase in power output.

Finally, the equation indicates that the total output of power is directly proportional to the density of the water. As seawater is 1000 times denser than air and a non-compressible medium, the total power output from marine turbines is proportionally greater than from wind turbines. For example, an 8 knot (14.8 km/h, 4.1 m/sec) tidal current is the equivalent of a 390 km/h wind.

These factors have the following implications for the design and location of marine current turbines:

- the stronger the water current the more power the marine current turbine produces, and
- the longer the rotor blades the more power the marine current turbine produces.

However, the above-mentioned factors have the following qualifications:

- if water currents are too strong they can damage the marine current turbine, and
- if the rotor blades are too long they can become unwieldy and more susceptible to damage, although the development of new technology is addressing this challenge.

Another important consideration is the efficiency at which marine current turbines convert the kinetic energy of water current (tides) into power (electricity). This is commonly expressed as the power coefficient, with the power produced by the turbine as a percentage of the power of the undisturbed seawater passing through an area equal to that swept by the rotor. For wind turbines, the power coefficient is generally less than 35%, although technological improvements are increasing wind turbines closer to the theoretical maximum of 59%. Early demonstration models of marine power turbines produced power co-efficiencies above 45%, and existing commercial models are operating between 45% and 60%.

4.4 Clarence Strait Energy Potential

The project has an area of approximately 1691 ha and is located within waters with a current minimum velocity of 2.0 m/sec. This would allow for 456 turbines at this location. The total amount of energy potentially present at the blade face of the tidal energy turbines at this location is approximately 12.07 MWh/m^2/year (enough electricity to power 194,000 households). The tidal energy turbines convert this kinetic energy into electrical energy. Annual electricity production is expected to be 1,036,000 MWh/year, which, based on the 2008 emission factor for consumption of purchased electricity from the grid for the Northern Territory, equates to annual greenhouse gas savings of approximately 731,500 tCO2e (Department of Climate Change. 2008). Such savings are equivalent to removing almost 3 million cars with a petrol engine from the road (SEAV, 2003).

4.4.1 Site Selection

Tenax Energy engaged Kellogg Brown & Root to re-instate the hydrodynamic modelling of Clarence Strait undertaken as part of the recently deferred development of Glyde Point (by the NT Government) to identify sites suitable for development of tidal power generators, based on the following two main criteria:

- reliable and consistent tidal currents, with velocities of above 2.0 m/sec for extended periods and flows that reverse in direction at 180 degrees with the change in tides, and
- proximity to existing electricity transmission infrastructure, to reduce power transmission and storage losses.

Water depth is another critical factor, with a minimum of 20 m required for a TEG. Deeper water allows higher MW-rated (i.e. larger) units, but current velocities are impaired close to the bottom of the flow column.

The proposed site at Clarence Strait was identified as the site with the greatest tide velocities in the greater Darwin vicinity. Clarence Strait experiences tidal variations of up to five m, producing extended periods of suitable tidal currents. The water depth in Clarence Strait varies from 25 to 50 m based on Australia Hydrographic Charts, which is adequate depth.

4.5 Turbine density

The density of turbines within the development area is limited by the impact that each individual turbine has on wake effects without impacting on the water velocity and therefore, the amount of energy that can be extracted by each turbine. The maximum density of turbines has been calculated to be approximately 27 turbines per square kilometre, or one turbine per 3.7 hectares. Each generator will produce approximately 2.3 GWh of electricity per year.

The exact number and placement of individual TEGs at the Clarence Strait Facility site will be the focus of further optimisation research and consultation with stakeholders.

4.6 Turbine design

4.6.1 Tidal electricity generators

The TEG design Tenax Energy is considering for deployment is based on the development of the highly efficient, integrated permanent magnet generator (PMG) located within the stator, with two separate technology developers achieving similar success with their designs. The service life of the generator is 25-30 years, and during that time it will generate electricity with zero greenhouse gas emissions, a modest footprint and negligible impact on marine life.

This technology has a slow moving rotor and lubricant free construction that minimises risk to marine life. It consists of a rotor, open centre, duct, stator and generator (Figure 4-1 and 4-2). The technology has minimal maintenance requirements because it has one moving part (the rotor), which has an open centre and spins within an outer rim or duct which contains the solid state permanent magnet generator.

Figure 4-1 OpenHydro tidal electricity generator

(Source: OpenHydro, 2007)

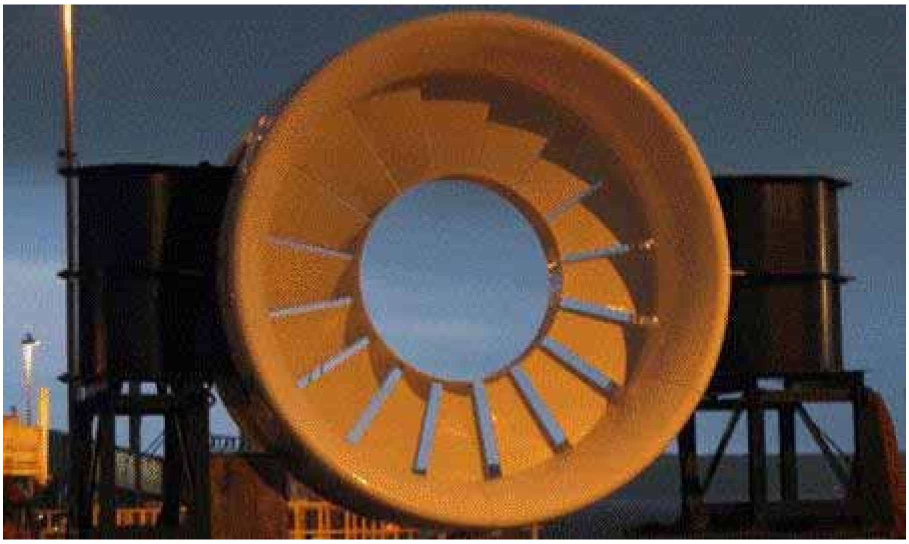
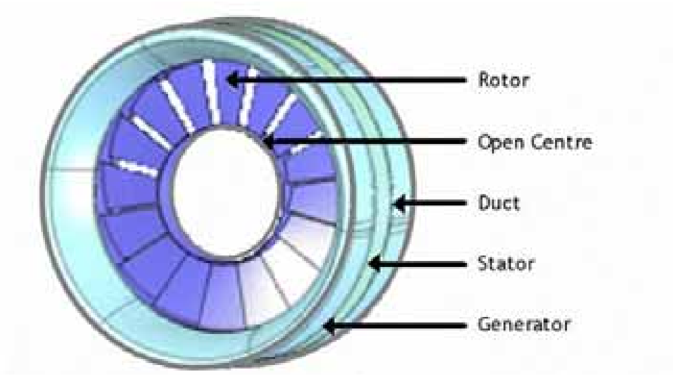


Figure 4-2 diagrammatically shows the design of the open centre turbine including the individual components, which are described in the following sub-sections. The combined height of the turbine and the base is approximately 18 m and the combined weight of the turbine and gravity base structure is approximately 160 tonnes.

Figure 4-2 Diagram of the component parts of the OpenHydro tidal electricity generator

(Source: OpenHydro, 2007)



4.7 Turbine Components

An open centre turbine consists of the following components. Based on the current specifications, each turbine will have the capacity of approximately 1MW. It should be noted however, that the precise specifications of the turbine components may change while the project is in the approvals phase.

4.7.1 Rotor

The rotor is a 15 m diameter single piece rotor that is the only moving part of the turbine. The turbine rotor blades are positioned on a slight angle to the turbine, hiding the long narrow gaps between the blades from the front-on view of the turbine. Water flow is directed through the gaps between the blades and as the water is redirected through the gaps, the flow exerts force on the rotor causing it to spin. The blade tips are retained within the outer housing of the turbine which eliminates the dangers associated with fast moving blade tips. When the rotor is spun within the stator it produces electricity.

4.7.2 Open centre turbine

An open centre turbine features a central void of 5 m within the rotor. The open centre increases the generating efficiency of the turbine and has the added benefit of providing an exit route for marine life.

4.7.3 Duct

The duct is the outer casing of the open centre turbine that is shaped to act as a venturi shroud, creating water flow and pressure variations that increase the efficiency of the turbine. The duct is of simple construction with clean hydrodynamic lines that affords limited opportunity for sea-life to become entangled.

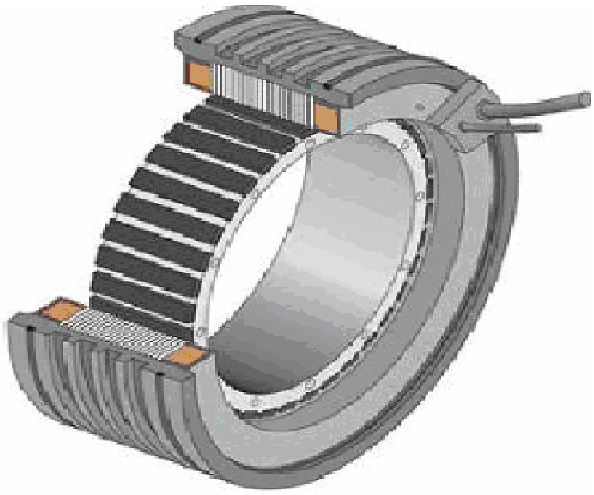
4.7.4 Stator

The stator is the stationary section of the turbine (located within the duct) that houses the generator components.

4.7.5 Generator

The TEG consists of a highly efficient, integrated permanent magnet generator (PMG) located within the stator, that use powerful neodymium permanent magnets and are brushless. The PMG turbines begin generating power at the first revolution and increases power with increasing revolutions per minute (RPM). The PMG can generate reasonable power at relatively low RPM, and in low-RPM applications it has a wide diameter and many poles; it is also commercially produced as a high torque motor (Figure 2-3).

Figure 4-3 Permanent Magnet Torque Motor Generator



The technology designers have adapted this concept for their generator design. The TEG rotor has its blades on the inside of the PMG ring. Wide diameter PMGs have the following significant advantages over other tidal turbine designs:

- no gearbox
- rotor and stator are totally sealed and water lubricated
- very long life and low maintenance, and
- operate at high efficiency at all RPMs.

4.7.6 Gravity Base

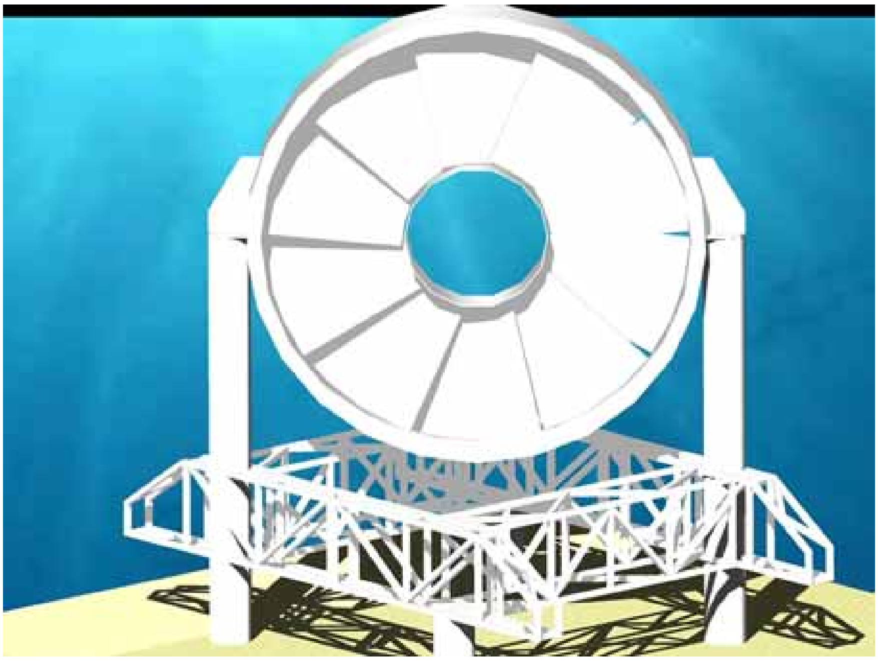
The turbine will be supported by a gravity base that will be positioned on the seabed. Figure 4-4 is a diagram of the turbine attached to the gravity base. The gravity base does not require any excavation of the seabed for mooring or foundations because it remains in place by virtue of its own weight.

The gravity base will be constructed of steel, with concrete and/or a combination of materials within the pylons to provide strength and weight. The optimal method will be determined through discussions and the normal tendering process with local contractors.

The structure design will allow light to pass through and reduce the impact on the seabed beneath the structure. The base will have dimensions of approximately 14 m by 21 m and will be approximately 3 m high.

The gravity base will be positioned on four vertical pylons that can be lengthened where required, to provide a level base where the seabed topography is uneven. Each pylon will be approximately 1.5 m in diameter and the base of each pylon will be the only part of the entire structure that directly contacts the seabed. Two of the pylons will extend above the gravity base to enable the turbine to be attached.

Figure 4-4 Diagram of Turbine on Gravity Base



The TEG units will be of a common design and will be interchangeable on the seabed supports. It is anticipated however, that there will be a requirement to customize each of the seabed support structures to some extent, to provide a stable base for the TEGs.

The OpenHydro TEG has a number of design features intended to avoid impact on marine life: the large open centre provides a safe passage for fish, crocodiles, dolphins and other marine animals; and the turbine's clean hydrodynamic lines mitigate the risk of entanglement. The blade tips are retained within the outer housing, and the turbine moves at a slow rotational speed (OpenHydro, 2007).

The TEG has only one moving part and no seals. It has a self-contained rotor with a solid state permanent magnet generator contained within the outer housing, minimising maintenance requirements. As there is no requirement for a gearbox and hydraulics, noise generated as a result of operation of the turbine is very minimal. The design also avoids the need for oils, greases or other lubricating fluids (OpenHydro, 2007).

4.8 Construction, Operation and Maintenance

4.8.1 Installation

The modular design of the OpenHydro Turbine allows the turbine and the gravity base to be installed separately. Additionally, the turbine can be removed from the base for maintenance or decommissioning.

Initially, a template of the base would be lowered to confirm the accuracy of the engineering and design at each particular location. The gravity base can then be installed using a small and cost-effective lift vessel to lower it into place.

The turbine would be constructed on-shore, and then lowered onto and fixed to the base using a small and cost-effective vessel to lower it into place as demonstrated in Figure 4-5.

Due to the simplicity of the design, the entire installation of each turbine onto the gravity base can occur during three periods of slack tide.

Figure 4-5 Tidal Turbine Installation

(Source: OpenHydro, 2007)

The construction, installation and commissioning process for the TEGs at Clarence Strait can be described in four steps:

1) Manufacture of the component parts – component parts including HV cables, generators and monitoring systems, will be manufactured in Australia as much as possible. Tenax Energy will purchase these from commercial suppliers, and the components would be shipped to Clarence Strait.

2) Installing the component parts – TEG units will be transferred from the shore based maintenance property in Darwin via barge to Clarence Strait. During periods of slack water, a conventional salvage vessel will lower the gravity base to the sea-floor at the selected location. The vessel will be required to remain within the channel during periods of slack tides. It will take approximately two days to complete installation of each turbine. The generating unit will then be lowered into place and attached to the base as much as possible by remotely operated vehicles (ROVs). This method is preferred over the use of divers, as evidenced in the North Sea oil and gas industry.

3) Connection of cable – the TEG will be connected to a transmission line and monitoring system. From here, the undersea HV cable will be connected and laid to shore via conventional cable laying techniques. From shore, the cable will be buried and will continue to the nearest substation;

4) Testing and commissioning – testing of the TEG system will be undertaken prior to commissioning, in accordance with the supplier’s certifications; this process would be detailed in the Installation and Commissioning Project Plan (ICPP) and is likely to consist of a set of milestone steps. Once initiated, power production from the TEG will be continuous throughout the year (albeit diurnal), with rates determined by tidal flows.

4.8.2 Operation

The tidal energy turbines will be operational during periods of tidal water movement. Thus, the operating times of the turbine are very predictable. It is estimated that tidal flows will be sufficiently strong for the turbines to operate for 70% of the time over a year. During periods of slack water (i.e. tidal water velocities of less than 0.7 m/s), the turbines will not be operating.

When operating, the rotor spins at a rate of between one and ten RPM (up to 47 km/h at the outside rotor next to the duct). There are no lubricants in the turbine.

Anti-fouling coating material may be required to minimise growth of marine biota on the turbine components. However, it is only likely to be required where there is no scouring by water sediment. Otherwise, the turbine is generally self-scouring.

Tenax Energy will develop an Operations Plan concurrently with the ICPP.

4.8.3 Maintenance

Tenax Energy will develop a Maintenance Plan concurrently with the ICPP prior to commencement of construction activities. The Maintenance Plan will detail annual visual inspections of the units, to ensure that fouling is minimised and integrity of the components is maintained. These inspections are likely to be undertaken using remotely operated vehicles. The following maintenance program has been proposed:

- an inspection of each turbine by remote operated vehicle will occur every year
- each turbine will be replaced by a reconditioned turbine every four years, and

- turbine maintenance will occur onshore.

One of the key advantages of the TEG design is that the infrastructure is a modular component system. This ensures that new improved technology can be installed periodically, for better efficiency or in response to local environmental conditions.

The TEGs will be taken offsite for refurbishment at regular intervals of around four years, and will need to be replaced every eight to ten years. The TEGs are lifted out of their brackets by salvage vessels for such maintenance. Tenax Energy anticipates that there will be an additional (replacement) TEG available to “swap” into place as a unit is removed for maintenance, so that power supply from the facility is not interrupted.

The shore based maintenance activities would be contracted to a local supplier in Darwin, taking one to two months to complete per unit. This will serve as the location for storing any new componentry brought in from elsewhere.

All HV cables from the facility will require regular and routine inspection (by remotely operated vehicles reinforced with divers if necessary) to ensure compliance with regulations.

4.8.4 Decommissioning

The design life of the TEGs is 25 to 30 years, with key generator components refurbished every five years and replaced every ten years.

The tidal energy turbines can be easily removed from the gravity bases. The bases will also be removed on decommissioning by removing and safely disposing of any ballast and then lifting the remaining parts off the seafloor. Following decommissioning of the turbines and bases, it is expected that there would be minimal impact on the seabed.

All components of the turbine, cable and gravity base will be recycled following the decommissioning of individual components and of the project as a whole.

4.8.5 Waste and Hazardous Substances

Waste streams generated by the construction and operation of the TEGs are expected to be very minimal. The generator units will be purchased from suppliers and installed complete, so construction activities will generate low volumes of waste cut-offs and packing from electrical wiring and cable-laying.

Operation of the generators will not require the use of lubricants, and anti-corrosion and anti-fouling agents that are accepted by marine industry standards will be used on the turbine blades and the concrete casing. The TEGs will be removed from the marine environment when cleaning and refurbishment is undertaken.

No hydrocarbons or hazardous substances will be required during operation of the facility.

4.9 Electricity Connection

4.9.1 Cable Route

An approximately 23 km long submarine cable and onshore power line will provide a link from the generators to the Darwin/Katherine power grid via the proposed infrastructure corridor from the former Glyde Point development site.

The network of turbines will be grouped into a series array, linking groups of 5 to 10 individual turbines in a cluster, to form a ring main circuit on the seabed. Each group will connect via the ring circuit to a centrally located submarine switch station. The switch station would be hermetically sealed and would self-bury in sandy environments.

From the switch station, a cable/s would transverse the seabed. The length of the submarine cable will be 22.98 km, of which approximately 2 km will be onshore to Glyde Point where it will reach a sub-station to be constructed at the northern edge of the proposed Glyde Point Infrastructure Corridor.

4.9.2 Electricity Flow

The cable will use a Direct Current (DC) as the HVDC submarine cable has superior environmental qualities compared to an Alternating Current (AC) cable. The flow will be converted to AC onshore.

4.9.3 Installation

In areas of soft sediment, the submarine cable will be installed by plough to a depth of approximately 1 m. This will provide a one-off relatively minor disturbance.

To protect the foreshore and dune areas, it is proposed that the cable be installed by horizontal directional drilling for a distance of approximately 250 m under the environmentally sensitive coastal area. If further environmentally sensitive areas are identified outside of the 250 m area, the length of cable installed by HDD can be extended as appropriate.

Section 5 Description of the Environment

5.1 Previous Environmental Assessments

URS has conducted searches for relevant environmental assessments that relate to the preferred development area and has not found any relevant studies. Therefore, it is difficult to specifically determine the environmental values of Clarence Strait and how the proposed development may impact on them without conducting environmental assessments. There is however, information available which enables a generalised description to be made of the physical environment of Clarence Strait.

5.2 Direct Impacts on Physical Environment

5.2.1 Bathymetry and Topography

Turbine Area

Clarence Strait has complex bathymetry in which three channels wind through the area, from Beagle Gulf in the west to the Van Diemen Gulf in the east. The channels range from 100 m to 1 km in width with the water depths varying from 25 to over 50 m (Australian Hydrographic Charts, 2008).

Submarine Cable

An approximately 23 km long submarine cable and onshore power line will provide a link from the generators to the Darwin/Katherine power grid via the proposed infrastructure corridor from the former Glyde Point development site. The cable will be trenched across the seafloor but as the physical footprint of the cable is small, displaced habitat is likely to affected only temporarily. The cable route has been selected to avoid the various reefs and coral outcrops in Clarence Strait.

5.2.2 Geology and Geomorphology

Turbine Area and Submarine Cable Alignment

Both the geology and the geomorphology of the Clarence Strait area will need to be further assessed to assist in the placement of turbines and to minimise potential impacts on the environment.

Shoreline Crossing

The HDD shore crossing will be to the north west of Glyde Point, which features reef structures to 500 m offshore. The onshore cable area is underlain by tertiary soils and laterite overlying Wangarlu Mudstone of the Bathurst Island Formation, which in turn overlies Koolpinyah Dolomite. These tertiary soils comprise of unconsolidated sand, ferruginous clayey sand and soil, clay soils, and commonly contain limonite pisolites. Tertiary laterite typically comprises nodular, concretionary, pisolitic and vermicular mottled laterite and ferricrete (Kellogg Brown & Root, 2003).

5.3 Marine and terrestrial species

A search of the Environmental Resources Information Network database of the Commonwealth Department of Environment, Water, Heritage and the Arts indicates the potential presence of 18 threatened species, including four birds, four mammals, six ray-finned fish, four shark and 67 listed marine species within the turbine and cable areas, as outlined below in Table 5.1.

Many of the species listed as potentially occurring in the area do not live underwater (e.g. seabirds,) and are very unlikely to be impacted by the proposed development as there will no impact near the sea surface. Other mammals and birds listed are potentially found around the onshore section of cable G (refer to Figure 3-1 attached) and not in the other turbine or cable areas.

Further surveys will need to be conducted to determine the level of impact that the project would have on benthic and pelagic species. However, the turbine has been designed to minimise physical interaction with marine species as there is a 5 m gap in the centre of the turbine through which marine organisms can easily pass, the rotor tips are contained within the outer rim, the turbines spins relatively slowly (up to 10 RPM) and the turbines operate quietly, thereby reducing the potential for acoustic impacts.

Benthic communities below the four piles of the gravity base of each turbine, an area of approximately 7 m^2 per turbine, will be impacted. However, the turbines and associated gravity bases can be sited to avoid sensitive sites. The process for this will be developed as part of the environmental management program.

There is a risk of encounters between marine biota and turbines. However, encounters only lead to collisions when the animal does not take appropriate evasive action. The behavioural reactions of marine species to turbines is undergoing further assessment, however it will depend on the sensory systems and agility of the species at risk, the visual, acoustic or other environmental signatures of the device and background conditions (Wilson *et al*, 2007). Appropriate mitigation options will depend on the specific design, species at risk and local environment. It is expected that species that can negotiate rapid currents are highly agile and will be readily able to avoid obstacles.

The operation of the turbines is predicted to create noise, mainly moving water noise and mechanical noise. The levels of anthropogenic noise produced by similar tidal stream devices has been found to exceed background noise in areas of low current speed, however “tidal devices will necessarily be sited in locations with strong tidal flows, and the ambient noise associated with these currents (e.g. sediment transport noise) could be significant, reducing the impact of the device noise” (Richards et al, 2007). Further, to minimise noise from the device the turbines have only one moving part, and as the turbines will spin relatively slowly (up to a maximum of 10 RPM) it is expected that noise will be of a low level and far less than boat propellers.

The cable will be trenched across the seafloor however, the physical footprint of the cable is small and displaced habitat is likely to temporarily affected.

Electromagnetic fields are typically generated wherever electrical current is present. Electrical fields will be eliminated by surrounding the cable with conducting materials that are grounded at each end of the cable. This ensures that no electrical fields are produced in the marine environment surrounding the cable. The potential for magnetic fields is eliminated by using twin DC cables that carry electrical current in opposite directions. The magnetic field generated by the cable is cancelled out by the other cable. However, the cables must be in relatively close proximity for the magnetic field to be eliminated.

Section 5 Description of the Environment

Table 5-1 Listed threatened species (or their habitat) that may occur within Turbine Areas and Cable Corridors

(Source: Commonwealth Department of Environment, Water, Heritage and the Arts

Group	Scientific Name	Common Name	Status	Location- Turbine Area					Location- Cable Section						
				1	2	3	4	5	A	B	C	D	E	F	G
Birds	*Tyto novaehollandiae kimberli*	Masked Owl (northern)	Vulnerable	-	-	✓	✓	✓	-	-	-	✓	-	-	✓
	Erythrotriorchis radiatus	Red Goshawk	Vulnerable	-	-	-	-	-	-	-	-	-	-	-	✓
	Erythrura gouldiae	Gouldian Finch	Endangered	-	-	-	-	-	-	-	-	-	-	-	✓
	Geophaps smithii smithii	Partridge Pigeon (eastern)	Vulnerable	-	-	-	-	-	-	-	-	-	-	-	✓
Mammals	*Balaenoptera musculus*	Blue Whale	Endangered	✓	✓	✓	-	✓	✓	✓	✓	-	✓	✓	✓
	Megaptera novaeangliae	Humpback Whale	Vulnerable	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓
	Dasyurus hallucatus	Northern Quoll	Endangered	-	-	-	-	-	-	-	-	-	-	-	✓
	Xermomys myoides	Water Mouse, False Water Rat	Vulnerable	-	-	-	-	-	-	-	-	-	-	-	✓

Group	Scientific Name	Common Name	Status	Location- Turbine Area					Location- Cable Section						
				1	2	3	4	5	A	B	C	D	E	F	G
Reptiles	*Caretta caretta*	Loggerhead Turtle	Endangered	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Chelonia mydas	Green Turtle	Vulnerable	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Dermochelys coriacea	Leathery Turtle, Leatherback Turtle, Luth	Vulnerable	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Eretmochelys imbricata	Hawksbill Turtle	Vulnerable	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Lepidochelys olivacea	Pacific Ridley, Olive Ridley	Endangered	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Narator depressus	Flatback Turtle	Vulnerable	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sharks	*Pristis zijsron*	Green Sawfish, Dindagubba, Narrowsnout Sawfish	Vulnerable	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Rhincodon typus	Whale Shark	Vulnerable	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Glyphis sp. C	Northern River Shark	Endangered	-	-	-	-	-	-	-	-	-	✓	✓	✓
	Pristis microdon	Freshwater Sawfish	Vulnerable	-	-	-	-	-	-	-	-	-	-	-	✓

5.4 Description of the Human Environment

5.4.1 Social

The area around the Clarence Strait Tidal Energy Project is sparsely populated. The nearest town is Howard Springs approximately 35 km away. The closest road is Gunn Point Road, while the closest city is Greater Darwin. On the northern side of the Strait is Melville Island, Tiwi Islands.

5.4.2 Economic

Economic uses related to the area include the revenue from scuba diving, boating and sailing, and recreational fishing tours and charters.

5.4.3 Recreation and Tourism

Recreational and tourism activities held with the area of Clarence Strait include the following pursuits:

- recreational fishing
- scuba diving
- boating and sailing, and
- commercial operators who provide the activities and services for tourists, including charter fishing tours, etc. are also include as part of the tourism industry.

5.4.4 Transport

There are navigable channels within Clarence Strait, which are commonly used as a route between the Beagle Gulf and Van Diemen Gulf. The preferred development area in Clarence Strait is within a moderate density route.

5.4.5 Cultural Heritage

Shipwrecks (including a known submarine wreck at the western entrance of the Clarence Strait) are presumed to occur within the vicinity for the preferred location for the proposed development (Lewis, 1997).

A native title claim is active over all Vernon Islands from the Larrakia and Jampalampi Tiwi Groups; however this claim is to the low water mark and as such, the turbine area and corresponding cables area are not within this claim.

This section of the report identifies potential issues associated with the development of TEGs. The potential environmental issues associated with the proposed TEGs can be divided into direct impacts and indirect impacts.

6.1 Potential Direct Physical Environmental Impacts

Potential direct environmental impacts are those that involve a direct impact of the turbines on the physical environment. Direct impacts potentially include impacts on coastal processes at the footprint of the turbines or direct impacts on marine biota during the operation of the turbines. Potential direct impacts on marine biota include colliding with the turbines or marine life being affected by the noise of the turbines operating or magnetic fields generated around the cable.

6.1.1 Bathymetry and Topography

Turbine Area

There are unlikely to be any impacts on seabed bathymetry as the turbines will be installed on a gravity base, which has extendable legs that can be extended to provide a level base on sloped or uneven surfaces.

Submarine Cable Alignment

The submarine cable will be trenched directly into the seabed and will not significantly alter the bathymetry of the seabed along the alignment.

6.1.2 Geology and Geomorphology

Turbine Area

The gravity base of the turbine will sit on the sea bed surface and will be held in place by virtue of its own weight. There will be no need to excavate the seabed to install any support structure. Therefore, there is unlikely to be any geological impacts on the seabed.

The active geomorphic processes at the turbine area will require further investigation. The amount and size of sediments within the water flow and natural seabed erosion will influence the final placement of individual turbines within the turbine area.

Submarine Cable Alignment

The submarine cable will be trenched into the sandy seabed along the submarine cable alignment to a depth of 1 m. Once buried, the cable is unlikely to affect any active natural processes on the seabed.

Shoreline Crossing

The shore crossing will be by way of HDD to the north west of Glyde Point, which features reef structures to 500 m offshore. The cable route has been selected to avoid the various reefs and coral outcrops along the southern coastline of Clarence Strait,

6.1.3 Marine Species

Habitat

The installation of the gravity base will result in disturbance of the seabed. The physical footprint of each individual turbine is limited to the footprint of the four pylons (approximately 7 m^2). Based on this area, 456 proposed turbines will have a direct physical footprint of approximately 3192 m^2. (0.32 ha) The weight of the gravity base and turbine is likely to disturb the seabed by smothering epibenthic biota immediately beneath the pylons of the gravity base.

The gravity base has an area of approximately 570 m^2 and will be located less than 1 m above the seabed. Indirect environmental impacts may occur directly underneath the turbines; however the design of the gravity base will allow light to penetrate, resulting in much less shading underneath the gravity base than would be the case if the gravity base was opaque.

The corresponding cable corridor will affect an area of approximately 2.3 ha (refer to Section 3.2.2). Baseline studies will be conducted for the entire project area to determine the location of significant benthic habitat. The individual turbines will then be sited so as to avoid any areas of significant benthic habitat.

Collision

The turbines have been designed to minimise any physical interaction with marine species as there is a 5 m gap in the centre of the turbine, the tips are enclosed within the outer rim and the turbine spins slowly (up to ten RPM).

Nevertheless, there is a risk of encounters between marine biota and turbine blades. Encounters only lead to collisions when the animal does not take appropriate evasive action. The behavioural reactions of fish and mammals to marine turbines requires further assessment – it will depend on the sensory systems and agility of the species at risk; the visual, acoustic or other environmental signatures of the device; and background conditions (Wilson *et al*, 2007). Appropriate mitigation options will depend on the specific design, species at risk and local environment. It is reasonable to expect that species that can negotiate rapid currents are highly agile and readily able to avoid obstacles.

Acoustic

The tidal turbines and gravity bases will be constructed onshore and lowered into place on the seabed. The process of lowering the gravity base into place and then fixing the turbines to the gravity base is expected to take three slack tide periods (three five hour periods when the tidal flow is low). Noise during construction is expected to be minimal and temporary, and therefore is unlikely to impact on marine species.

The operation of the turbines is predicted to create noise, mainly moving water noise and mechanical noise. The levels of anthropogenic noise produced by similar tidal stream devices has been found to exceed background noise in areas of low current speed, however “tidal devices will necessarily be sited in locations with strong tidal flows, and the ambient noise associated with these currents (e.g. sediment transport noise) could be significant, reducing the impact of the device noise” (Richards *et al*, 2007). Further, to minimise noise from the device the turbines have only one moving part, and as the turbines will spin relatively slowly (up to a maximum of 10 RPM), it is expected that noise will be of a low level and far less than boat propellers.

6.2 Indirect Impacts on the Physical Environment

Indirect impacts could include the introduction of pest species or diseases or pollution of the natural environment by chemicals used as surface finishes.

It is considered that there are unlikely to be significant adverse indirect environmental impacts for the following reasons:

- anti-fouling treatments will only be used on those parts of the turbine that are not self-scouring, reducing the potential impact of heavy metal pollution from such paint, and
- an Environmental Management Plan will be prepared for construction, operation and maintenance of the facility that will outline measures to prevent introduction of marine pest species.

6.2.1 Environment benefits

To offset these (relatively minor) environmental impacts, there will be considerable positive indirect environmental impacts through reductions in greenhouse gas emissions by replacing fossil-fuel generated electricity supply with clean tidal power.

6.3 Health

It is considered that there will be no direct or indirect impacts on human health associated with the proposed TEGs and cable. The project will have some impacts on the physical environment, and the only impact that may lead to impacts on human health would be pollution of commercial fisheries. However, as outlined previously, an Environmental Management Plan will be prepared to manage and mitigate potential environmental and by extension, human health impacts.

6.4 Economic

The potential economic issues associated with the proposed TEGs and cables can be divided into direct impacts and indirect impacts.

6.4.1 Direct Economic Impacts

Potential direct economic impacts are those associated directly with the proposed turbines and cable such as the direct economic benefit of the energy generated by the project or the economic loss associated with the displacement of an existing use.

Local employment opportunities will be created during the installation and commissioning process, which is expected to engage up to 30 professional and trades people.

While the Clarence Strait project alone is unlikely to support full time staff for operations and monitoring, further development of future tidal power projects could be expected to create a permanent base in Darwin, possibly providing employment for up to five permanent skilled and ten semi-skilled staff.

Annual visual inspections, and servicing and refurbishment of the TEGs by local electrical, engineering and marine contractors is also likely to generate employment, for up to five full-time-equivalent staff.

As previously discussed, the TEG project will benefit the Northern Territory by providing power infrastructure that is reliable, long-term and based on an alternative source from the current gas-based supply. It is anticipated that demand for electricity within the Northern Territory community could exceed supply within two years

(Utilities Commission, 2006), and therefore Tenax Energy's TEG project provides a utility to meet an identified need for greater capacity.

6.4.2 Indirect Economic Impacts

Potential indirect economic impacts include restrictions on current economic uses of Clarence Strait such as fishing. There will most likely be the need for some restriction on fishing in the project area, limiting the use of trawl and dredge fishing methods within the turbine array. Sport fishing is mainly confined to the shallow reefs and should be must less affected by fishing exclusions around the turbine areas.

6.5 Social

Potential social impacts could include impacts of employment generation or potential impacts on cultural heritage, tourism and recreation.

6.5.1 Cultural Heritage

Aboriginal Cultural Heritage

A native title claim is active over all Vernon Islands from the Larrakia and Jampalampi Tiwi Groups; however this claim is to the low water mark and as such, the turbine area and corresponding cables are not within this claim.

Non Aboriginal Cultural Heritage

Shipwrecks (including a known submarine wreck at the western entrance of the Clarence Strait) (Lewis, 1997) are presumed to occur within the vicinity for the preferred location for the proposed development. A detailed survey to determine the location of any of these wrecks within the proposed development area should be undertaken as the precise locations of the shipwrecks are not readily available on either the Northern Territory Government or the Commonwealth Government historic shipwrecks database websites.

6.5.2 Recreation and Tourism

The impact of the proposed development on boat based recreation is dependent on what restrictions are required for the surface above the proposed location. The full impacts of the development on recreation and tourist values will need to be addressed. As noted above reef sport fishing should not be significantly impacted by this project.

6.6 Transport

The preferred development area in Clarence Strait is within a moderate density transport route. However, the turbine areas will not be an exclusion zone for most shipping, since the preferred development area contains water depths of up to 50 m, which would leave sufficient water depth between the highest point of the TEGs and sea level to enable vessels to pass above. There will be some minor constraints on the movement of submarines which will obviously need to avoid the turbines.

7.1 Consultation

Tenax Energy has to date consulted with officers from the following Northern Territory Government departments:

- Department of Natural Resources, Environment and the Arts (NRETA)
- Environment Protection Authority
- Department of Business and Employment
- Department of Chief Minister,
- Aboriginal Areas Protection Authority
- Commonwealth Department of Climate Change, and
- Commonwealth Department of Environment, Water, Heritage and the Arts.

7.2 Further Consultation

Further consultation will occur with state government, local government, environment groups, fishing groups, local community, and indigenous groups, to meet the proponent's Triple Bottom Line assessment.

Section 8 Proposed Surveys and Studies

Tenax Energy is proposing to conduct the following surveys and studies at the project area:

- assessment of potential impacts on marine biota
- assessment of potential impacts on recreational activities
- assessment of potential impacts on marine and coastal processes (bathymetric surveys to include a marine reflection seismic survey to determine the general seabed strata and characteristics of the areas in question), and
- assessment of potential impacts on cultural heritage.

9.1 EPBC Act Referral

An EPBC referral has been submitted to the Commonwealth Department of Environment, Water, Heritage and the Arts for the project. It is envisaged that the project will be considered an uncontrolled action under the EPBC Act.

9.2 Project Timetable

The installation at the site is expected to commence in 2011, once environmental approvals are gained. Installation is expected to take approximately one year per sub-area to complete. To manage the increased capacity on the Darwin/Katherine electricity grid, the project site will be developed in several phases.

Section 10 Legislative Consent and Licensing Requirements

The proposed Clarence Strait site is located entirely within the jurisdiction of the Northern Territory. The boundary between Northern Territorian jurisdiction and Commonwealth jurisdiction is the three nautical mile line from the land boundary. Based on the maps provided by Kellogg, Brown & Root, all of the suitable areas for a tidal power generator development are located inside the three nautical mile limit and therefore, are subject to Northern Territorian legislation. However, some Commonwealth legislation applies in addition to Northern Territorian legislation as outlined below.

Commonwealth Legislation

Historic Shipwrecks Act 1976

Native Title Act 1993

Environment Protection and Biodiversity Conservation Act 1999

Aboriginal Land Rights (Northern Territory) Act 1977

Northern Territory Legislation

Environmental Assessment Act (NT)

Electricity Reform Act

Heritage Conservation Act

Northern Territory Aboriginal Sacred Sites Act

Northern Territory Land Corporation Act

Parks and Wildlife Commission Act

Power and Water Corporation Act

Soil Conservation and Land Utilization Act

Waste Management and Pollution Control Act

Water Act

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Section 12 Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Tenax Energy Pty Ltd and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 25 July 2007.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between July 2008 and December 2008 and is based on the information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

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