



The Pelamis is designed with a rapid attachment/detachment system which allows machines to be towed back to sheltered water for maintenance. The system is designed to avoid the use of specialist equipment, divers or ROVs. All maintenance activities are able to be carried out with the machine afloat at a quayside location.

All internal components are modular and can be installed/removed by standard 5T mobile crane.

The Pelamis contains three Power Conversion Modules, each rated at 250kW. Each Power Module contains a complete electro-hydraulic power generation system.

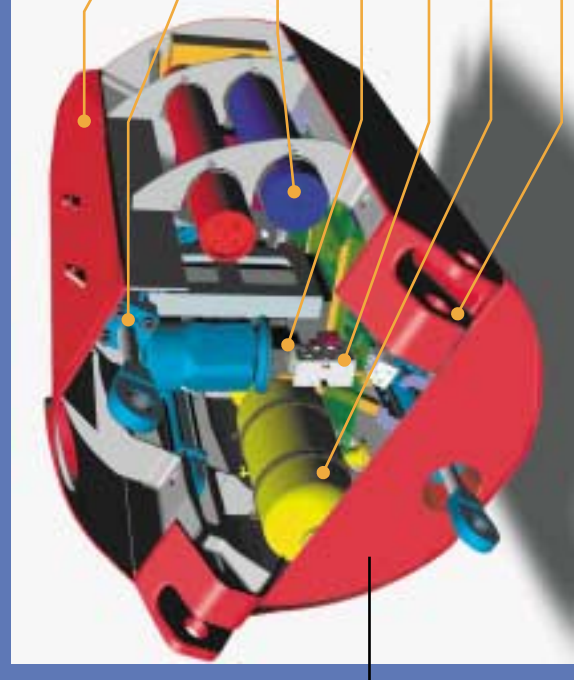
SPECIFICATIONS

STRUCTURE	
Overall length	150m
Diameter	3.5m
Displacement	700 tonnes (including ballast)
Nose	5m long, drooped conical
Power take off	3 independent power conversion units
POWER CONVERSION UNIT	
Power take off	4 x hydraulic rams (2 heave, 2 sway)
Ram speed	0 – 0.1m/s
Power smoothing/storage	High pressure accumulators
Working pressure	100 – 350 Bar
Power conversion	2 x variable displacement motors
Generator	2 x 157kVA / 125kW
Speed	1500rpm
POWER	
Overall power rating	750kW
Annual output	2.7GWh
Nominal wave power	55kW/m



PELAMIS

The Pelamis installed on site at the EMEC test centre, Orkney.



Internal view of a Pelamis Power Conversion Module.

- Power Conversion Module
- Main Tube Segment
- Sway (vertical axis) hinged joint
- Hydraulic ram
- High pressure accumulators
- Motor/Generator set
- Manifold
- Reservoir
- Heave (horizontal axis) hinged joint

Hydrostatic power limiting
Generator type
System voltage
Transformer

SITE MOORING

Depth
Current
Mooring system

COMPARISONS

Equivalent gas turbine – fuel
Equivalent gas turbine – CO₂ emissions

>6 – 7m significant wave height
Asynchronous
3-phase, 415/690Vac 50/60Hz
950kVA step up to typ. 11kV or 33kV

>50m
<1 knot
Compliant, slack moored

600 tonnes/year
2000 tonnes/year

OPD reserves the right to change specifications without notice. Patents: US6476511, AU754950, ZA20072008, EP1159766; other patents pending.

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750kW

PELAMIS P-750 WAVE ENERGY CONVERTER

OCEAN POWER DELIVERY LTD.

Offshore wave energy



The Pelamis P-750 Wave Energy Converter is the result of six years of extensive testing, modelling and development by Ocean Power Delivery Ltd.

The machine is a semi-submerged, articulated structure composed of cylindrical sections linked by hinged joints. The wave-induced motion of these joints is resisted by hydraulic rams, which pump high-pressure oil through hydraulic motors via smoothing accumulators. The hydraulic motors drive electrical generators to produce electricity. Power from all the joints is fed down a single umbilical cable to a junction on the sea bed. Several devices can be connected together and linked to shore through a single seabed cable.

A novel joint configuration is used to induce a tuneable, cross-coupled resonant response, which greatly increases power capture in small seas. Control of the restraint applied to the joints allows this resonant response to be 'turned-up' in small seas where capture efficiency must be maximised or 'turned-down' to limit loads and motions in survival conditions. The machine is held in position by a mooring system, comprising of a combination of floats and weights which prevent the mooring cables becoming taut. It maintains enough restraint to keep the Pelamis positioned but allows the machine to swing head on to oncoming waves. Reference is achieved by spanning successive wave crests.

The Pelamis is designed to be moored in waters approximately 50-70m in depth (typically 5-10km from the shore) where the high energy levels found in deep swell waves can be accessed.

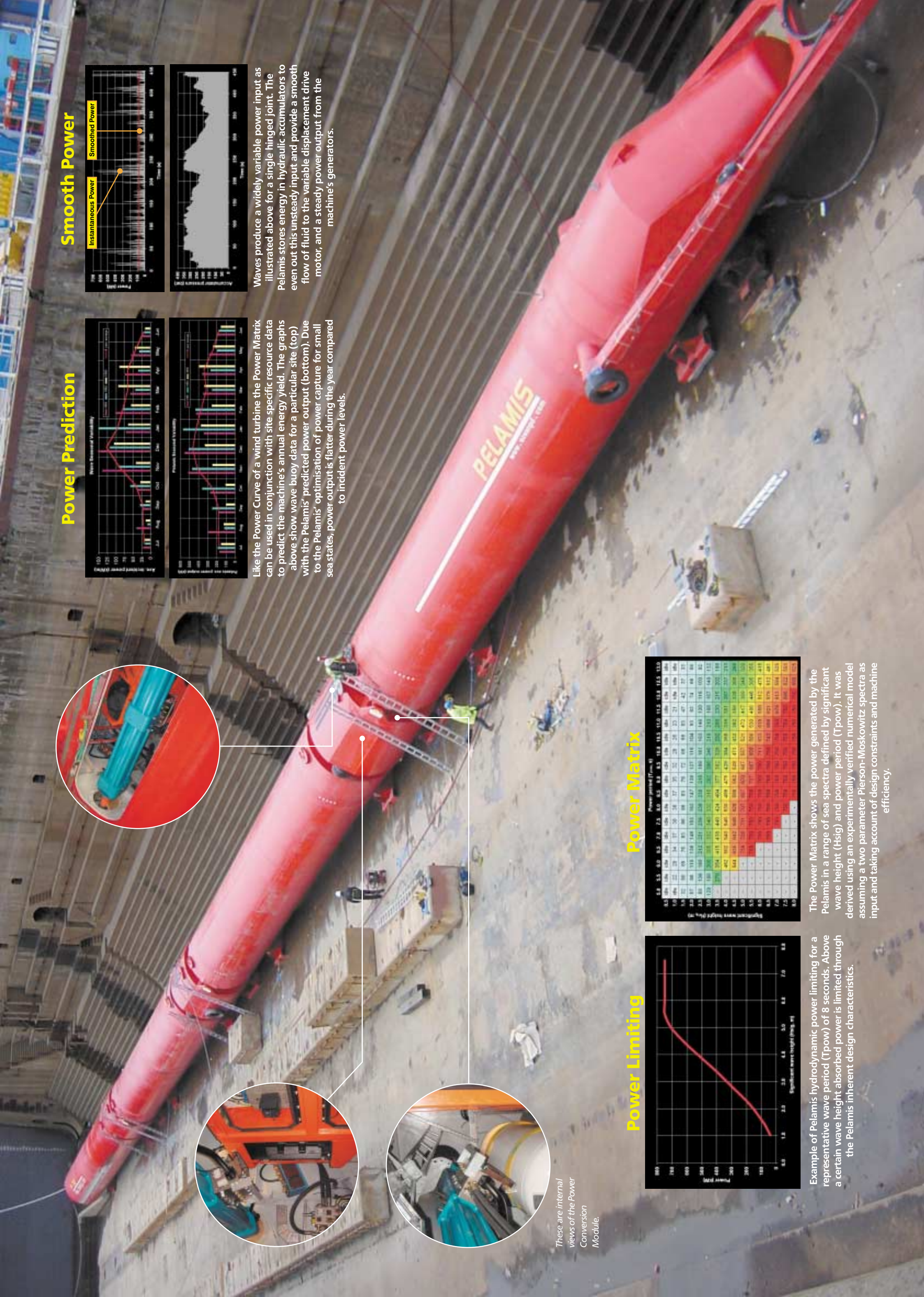
The design of the Pelamis has been independently verified by WS Atkins according to (DNV) offshore codes and standards.

KEY FEATURES

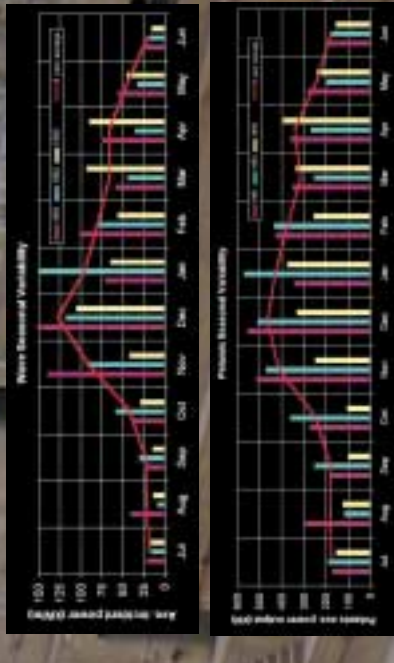
- SURVIVABILITY**
 The core theme of the Pelamis WEC concept is survivability. All Wave Energy Converters absorb power in small waves through HYDROSTATIC forces – that is buoyancy versus weight or hydrostatic pressure. However extreme loads in waves arise from the HYDRODYNAMIC forces, namely inertia, drag and slamming. The Pelamis is very strongly coupled hydrostatically but is almost invisible to large hydrodynamic effects.
- 100% AVAILABLE TECHNOLOGY**
 The Pelamis is an assembly of proven technology from the offshore oil and gas sector.
- NON SITE SPECIFIC**
 The Pelamis is designed for offshore locations with water depths of 50 – 100m, giving maximum flexibility and scalability.
- MINIMUM ON-SITE WORK**
 The Pelamis is constructed, tested and maintained off-site with a minimum of installation work required on-site.
- POWER CAPTURE EFFICIENCY**
 The Pelamis can be tuned to match conditions and optimise energy extraction.
- DESIGN INDEPENDENTLY VERIFIED**

PELAMIS

P-750 WAVE ENERGY CONVERTER

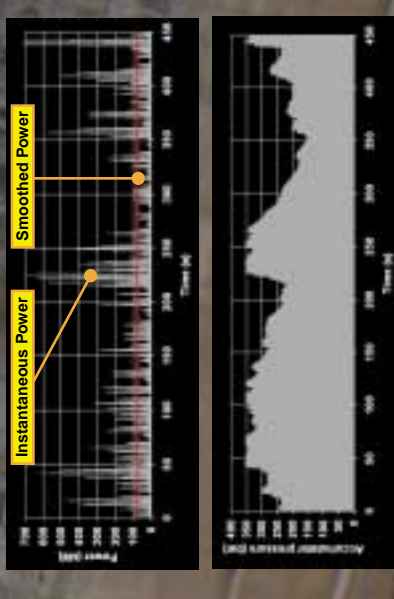


Power Prediction



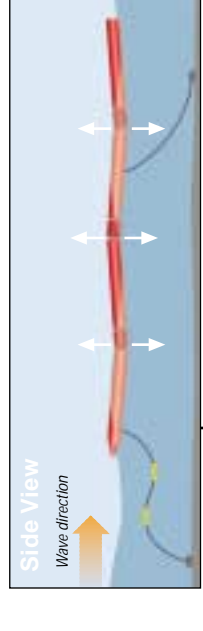
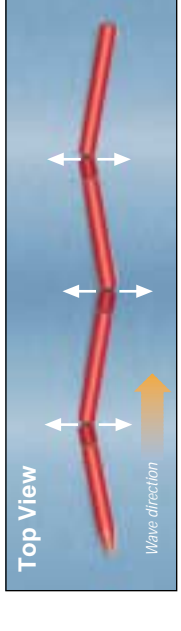
Like the Power Curve of a wind turbine the Power Matrix can be used in conjunction with site specific resource data to predict the machine's annual energy yield. The graphs above show wave buoy data for a particular site (top) with the Pelamis' predicted power output (bottom). Due to the Pelamis' optimisation of power capture for small sea states, power output is flatter during the year compared to incident power levels.

Smooth Power



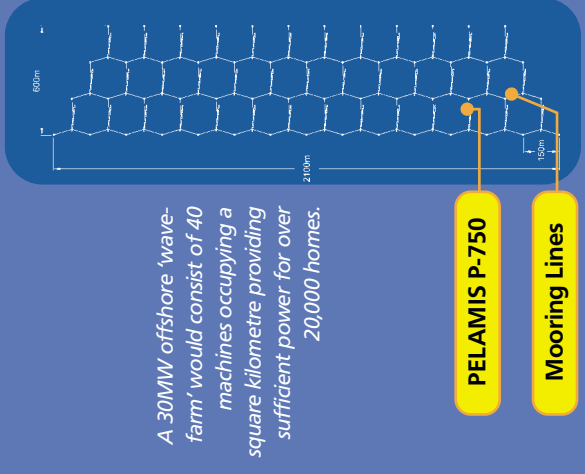
Waves produce a widely variable power input as illustrated above for a single hinged joint. The Pelamis stores energy in hydraulic accumulators to even out this unsteady input and provide a smooth flow of fluid to the variable displacement drive motor, and a steady power output from the machine's generators.

The Pelamis Wave Energy Converter is a semi-submerged, articulated structure composed of cylindrical sections linked by hinged joints.



The wave-induced motion of these joints is resisted by hydraulic rams which pump high pressure fluid through hydraulic motors via smoothing accumulators.

The hydraulic motors drive electrical generators to produce electricity. Power is fed to the seabed via a single dynamic umbilical connected to a transformer in the machine's nose.



A 30MW offshore wave-farm would consist of 40 machines occupying a square kilometre providing sufficient power for over 20,000 homes.

PELAMIS P-750

Mooring Lines

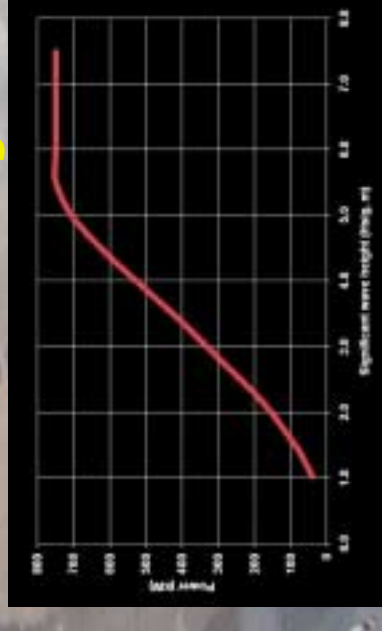
Artist's impression of a 30 MW wave farm

Power Matrix

Significant wave height (Peak, m)	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0																																																																																																										
Power (kW)	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305	310	315	320	325	330	335	340	345	350	355	360	365	370	375	380	385	390	395	400	405	410	415	420	425	430	435	440	445	450	455	460	465	470	475	480	485	490	495	500	505	510	515	520	525	530	535	540	545	550	555	560	565	570	575	580	585	590	595	600	605	610	615	620	625	630	635	640	645	650	655	660	665	670	675	680	685	690	695	700	705	710	715	720	725	730	735	740	745	750	755	760	765	770	775	780	785	790	795	800	805	810	815	820	825	830	835	840	845	850	855	860	865	870	875	880	885	890	895	900	905	910	915	920	925	930	935	940	945	950	955	960	965	970	975	980	985	990	995	1000

The Power Matrix shows the power, generated by the Pelamis in a range of sea spectra defined by significant wave height (Hsig) and power period (Tpow). It was derived using an experimentally verified numerical model assuming a two parameter Pierson-Moskowitz spectra as input and taking account of design constraints and machine efficiency.

Power Limiting



Example of Pelamis hydrodynamic power limiting for a representative wave period (Tpow) of 8 seconds. Above a certain wave height absorbed power is limited through the Pelamis inherent design characteristics.

These are internal views of the Power Conversion Module.