Ocean Met is a Re-Usable Self Installing Floating Meteorological Mast / Lidar Platform for Water Depths Deeper than 60m.

Ocean Energy & Resource Ltd.
Ocean Met is designed in every aspect by Xanthus to save its owners and operators money.

Ocean Met is vastly cheaper to manufacture and deploy than comparable systems but more than that, its simple design philosophy offers huge flexibility in operation and location.

Ocean Met offers further ongoing advantages once in operation by reducing medium and long term cost through its ease of maintenance and its ability to be simply redeployed or recovered back to shore for refit thus maximizing economical service life.

Ocean Energy & Resource Ltd
Castlegate Business Park
Portskewett
Caldicot
NP26 5AD
United Kingdom

Telephone: +44 (0)1291 40 80 88 Email: enquiry@oceanresource.co.uk

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Ocean Met comes in two versions: Ocean Met-M is a re usable self installing offshore meteorological mast utilising a taught moored facility designed for water depths from 60m to over 200m, consisting of a buoyant structure supporting the telescopic mast, moored by multiple tethers to a gravity base on the sea bed. Ocean Met-L uses the same buoyant hull technology but provides a platform to accommodate a wind Lidar instrument and supporting power system.

Ocean Met is fully built and assembled on shore, and then using a standard ocean tug the whole structure easily deployed offshore in two trips lasting a matter of a few hours each, thus also mitigating the uncertainties of weather.

Ocean Met is easily recovered and redeployed with minimal legacy impact, meaning that instead of using multiple fixed masts that soon become redundant, a single Ocean Met could be re located annually many times at a fraction of the cost of a new build.

Ocean Met is self powered and supports a wide range of atmospheric and oceanic instruments.
**Design Philosophy**

Ocean adopted a problem-led approach to firstly create a holistically designed structure from top to base specifically for deeper water sites and to overcome the fatigue and corrosion issues plaguing the meteorological masts currently employed offshore by the wind industry. **Ocean Met** has a design life of 25 years.

Secondly, Xanthus has designed from the start on the basis that flexibility of location and the ability to easily and cheaply relocate meteorological masts is paramount to wind farm developers to ensure that they can maximise the design, density and size of any potential wind farm zone.

Thirdly, Xanthus acknowledged that **Ocean Met** must be easily deployable and recoverable with nothing more than standard offshore tugs in order to offer wind farm developers both the flexibility of very short lead times for deployment and relocation and remove the current cost impediments of doing so.

Utilising current budgets planned for a single mast, wind farm developers could now alternatively employ multiple **Ocean Mets** within the development zone. **Ocean Met** also opens up the possibility of multipoint testing to either expand existing developments or to maximise the density and size of future planned sites.

**Mast**

**Ocean Met**-M uses a large buoyant hull as the mast support structure consisting of several watertight tanks housed in a large tubular hull around a central circular shaft which acts as a secure housing for the retracted mast when not in use. When the mast is retracted into the hull the open end is sealed to protect it during deployment and to make the whole unit watertight during transport and installation.
In operation the bulk of the structure is designed to remain well below the surface with only the central circular shaft protruding above the water. This central tube supports a boat landing deck and ladder to a working platform above.

The mast housed within the central shaft is a self-supporting rectangular sectional telescopic lattice structure that can be deployed to over 100m above the surface and which can be fitted with a wide array of booms, data instruments, wind turbine generators and also solar panels to charge the UPS (Uninterruptible Power Supply) providing continuous power for the mast.

The mast sections are sequentially telescoped to the required height by the installation crew operating on the working platform starting with the top mast section first. As the mast is deployed, all ancillary booms and equipment and wiring looms are installed from the platform deck and then raised with the tower without out any need to climb the mast.

Each section is fully extended into wedged joining sections that are then through bolted to provide a high-integrity moment transfer throughout the whole structure. Electrical continuity will also be established throughout the mast to provide for lightning protection. The lowest telescopic section contains a large watertight compartment at its base, the top of which sits flush with the working platform when the mast is fully deployed.

This compartment contains the UPS battery bank, together with all control systems, transceivers, power supplies, data storage and associated equipment necessary. The control room is accessed through a watertight hatch and allows technicians’ full weather protection at all times.

Ongoing routine servicing and maintenance is achieved through a full height access ladder fitted with a certified fall arrestor on the tower. However for major works the tower can be lowered to the platform if necessary providing a safe working environment.
**Lidar Platform**

*Ocean Met-L* uses a tubular mast that rises from the hull. Mounted on top of the mast is a working platform which provides a space for the Lidar system associated solar panels and WTGs which recharge the battery bank. A typical layout is shown below though the size of this platform can be adjusted according to the specific requirements.

A boat landing deck provides access to the mast and the hull.
The hull accommodates the UPS battery bank, together with all control systems, transceivers, power supplies, data storage and associated equipment necessary. The control room is accessed through a watertight hatch from the boat landing deck and allows technicians’ full weather protection at all times.

**Foundation**

Both Ocean Met products use a buoy that is attached to a Gravity Base Structure (GBS) through tether cables anchored into the foundation through force dissipating outriggers.

Each tether comprises a spiral steel bridge strand wire, galvanised and sheathed in high density polypropylene for corrosion protection. The exterior of each tether has a silicon based antifouling coating to reduce marine growth.

On the buoy these tether cables are attached through fabricated universal joints with low friction bearing surfaces to outriggers positioned below the ocean surface.

The concrete Gravity Buoyant Structure (GBS) typically comprises a rectangular multi-cellular hollow reinforced concrete structure of proven design. It is self-floating and when de-ballasted its inherent buoyancy is used to aid towage and installation. No specialised vessels or heavy-lift facilities are required during installation hence reducing costs whilst also increasing project flexibility.

During sea tow and installation, the GBS and sealed tubular hull provide buoyancy and are designed to withstand the environmental forces of towage and the hydrostatic pressure of submerging to up to 60m. The buoyancy is augmented by additional temporary buoyancy which is provided to aid installation.
When it is installed at its operating location, the GBS’s function is to maintain the stability of the mast by providing a fixed support structure for the mast without the need for expensive piling.

The gravity base is inherently very strong obviating the need for reserve buoyancy during towage. Once the floating gravity base structure is in position, the cell groups are ballasted with seawater through ballasting pipes cast into the gravity base itself. The ballasting process is controlled through an equalising system to ensure even distribution of seawater throughout all cell groups.

The installation procedure can be reversed by pumping air in to the air vent pipes, also located on the gravity base top slab at any time. A watertight manhole located at the top of each cell provides access for inspections and during construction.

In general no sea bed preparation is required. The submerged weight of the gravity base and the applied loadings are transferred to the seabed soil foundation via footpads set in the underside of the gravity base. These pads can be tailored to meet a specific site’s characteristics in relation to level or other seabed conditions (i.e. cohesion free or cohesive soil, silt etc.). The GBS is free draining to stop any liquefaction of poor soils from hydrodynamically induced pressures, and if required a steel skirt can be attached to the outside perimeter of the gravity base that will penetrate into the foundation soil to provide better lateral resistance and a level of scour protection. Where soil conditions are very poor the skirt can also be designed as a suction pile.

Any erosion would be considered on a site by site basis, but will be mitigated if necessary through the use of artificial seaweed or a small rock dump.

**Construction**

*Ocean Met* may be built in a dry dock, on a quayside or on a slipway. Final construction will depend on the facilities available. Xanthis personnel have used all three techniques for the construction and launch of large gravity bases. The GBS is a relatively simple construction using standard rented formwork and ready-mixed grade 45 concrete reinforced with steel reinforcement.

The steel tubular hull comprises a partially stiffened external pressure vessel fitted with guides for the mast sections and associated appurtenances. The mast sections are of conventional tube and solid bar construction.

All the batteries and equipment are pre-installed in the control room (located in the lower tower section). Batteries are a leak-free gel-type capable of operation in any plane. All equipment and support systems are designed to be transported at right angles to their normal operating orientation for sea towage. The telescopic mast sections are assembled together and installed within the central tubular hull section to form the integrated mast. The tubular section is then sealed watertight for transport. The integrated mast is then lifted into the water and secured for sea transport.
These images show typical Buoy transport arrangements. However, it is also possible to deploy a buoy in the vertical orientation and this will eliminate offshore lifting.
**Preparation**

For **Ocean Met-M**, the telescopic mast sections are assembled and stored within the buoy central tube section. All the batteries are pre installed in a watertight compartment and cable runs are prepared and checked.

For **Ocean Met-L** the working platform is setup with all the Lidar and other instruments in place as well as the battery bank and cable runs checked.

The instrument booms, fixings, solar panels and Wind Turbine Generators (WTG) power systems, monitoring equipment etc are all then set up, pre-wired and bench tested before being sealed and loaded for transport.

**Two stage installation.**

**Ocean Met** is designed to be much simpler and more economical to install and commission than traditional offshore masts, with over 80% of the assembly work taking place onshore.

The **Ocean Met** buoy is installed in a two stage operation in a single trip, namely setting the gravity base (GBS) and deploying the buoy structure. Both can be installed as self-floating units using techniques that have been used many times by the Ocean Group.

Firstly the GBS is towed to site and positioned using a main and assisting tug. The GBS is ballasted using sea water to the seabed and is set in its required location. Special patented features accommodate a wide range of seabed conditions and facilitate later removal of the GBS.
No specialised vessels are required for installation. A standby tug is used to escort Ocean Met during the tow in case of emergency manoeuvring. This second tug is also used to expedite positional control and ballasting during installation.

The buoy structure can also be brought to site as a floating unit in a horizontal attitude (as shown below) or vertically orientated. (it can alternatively be brought by a barge for longer distance deployments).

The four tether cables attached to the Gravity Base Structure are held floating under the surface attached to locator buoys above. The buoyant hull is then towed into position above the GBS. The pull down installation cable is then used to draw the buoyant structure upright and then down under the surface. The four tethers are retrieved and connected to the outriggers in an operation lasting only a few hours. Once tethered to the GBS Ocean Met is safe and secure. From now on all assembly work is carried out from the work platform which is accessed via the boat landing.

For Ocean Met-M, the extension of the mast sections is controlled from the work platform. The mast sections are erected using an air or hydraulic winch located on the work platform. Motive power for this is supplied from the designated work boat (probably the second tug). The mast sections are raised using a pre-rigged cable system. The upper section is installed first followed by the next lowest section in order. As each mast section is extended from its stored position, the booms carrying the aeronautical light, anemometers and other instrumentation are attached and the equipment fitted and checked. The wind turbine power (WTG) systems and solar panels are passed over from the designated workboat using a temporary davit jib crane located on the work platform. The system is then commissioned.

Ocean Met-L is ready for final commissioning as soon as the buoy is tethered.

This rapid installation process considerably raises efficiency and slashes installation costs by some 80%.
**Ocean Met** is designed to be left for long periods monitored remotely without the need for service and maintenance. An annual inspection is envisaged.

**Redeployment**

Once the required data has been collected on station, **Ocean Met** can be easily recovered and redeployed to a new location.

Decommissioning is a simple reversal of the installation process. First the mast sections are retracted starting from the lowest section and as this is accomplished all booms and equipment are removed and stored. Any other non-watertight equipment is removed.

Once the tubular section is sealed the buoy is detached from the foundation tethers and towed away, and the GBS is de-ballasted to return it to the surface. The footpads can be detached to aid this operation where cohesive soil is encountered.

If maintenance, inspection or repair is required, SeaMet is towed back to shore prior to redeployment.
**Ocean Met-M Outline Technical Specification**

Mast Height- 100m nominal (Free standing lattice tower).

Tower- Self erecting with square cross-section construction using tubular and solid tube 200mm diameter to 18mm diameter.

Reference Wind Speed- 40.5 m/s
Survival Wind Speed- 68.2 m/s
Vertical Load Capacity- 12 kN
Icing (Tower) - 15mm thickness assumed for circular bar cross-section.

General Design Standards
- ISO 19906 (draft) - Petroleum and natural gas industries -- Arctic offshore structures.
- API RP 2A Recommended Practice for Planning, Designing And Constructing Fixed Offshore Platforms.
- BS EN 61400 Design requirements for offshore wind turbines.
- Concrete Foundation Structure BS EN 1992, Eurocode 2: Design of concrete structures or equivalent.

Coating
- Galvanised & Painted Mast.
- Marine specification coating for subsea components.
- Special coating for foundation components where required.
Monitoring Equipment

Both Ocean Met products typically come with a comprehensive package of meteorological measuring Instruments already inclusively priced in, but wide range of additional configurations can easily be tailored to client’s specification. Please contact Xanthus to discuss your requirements. All instruments are remotely monitored with data streaming over GSM or Satellite Network into a WAN.

- Weatherproof and climate controlled equipment room to contain.
- All cabinets, mountings, terminal assemblies and switches.
- Large battery pack with minimum 15 days stored power supply.
- Power system for the loggers, meteorological instruments and navigational aids to include Photovoltaic (PV) panels, Wind Turbine Generators (WTB’s) and regulators.
- Two loggers to collect Meteorological data. Campbell Calibrated scientific CR3000 with expansion modules, 2GB storage and typical peripherals.
- Logger to control power consumption and navigational aids.
- GPS modem and antennae for communication via mobile phone network. Or Satellite communications equivalent.
- Measnet calibrated anemometers. (X’s 6) (Ocean Met-M only)
- 3D ultrasonic anemometers. (Ocean Met-M only)
- Wind Vanes. (X’s 2)
- ZephIR 300 Lidar unit in marinised casing (OceaMet-L specific)
- Probes with radiation shield to measure temperature and Relative Humidity.
- Ambient pressure sensor.
- Water CTD (Conductivity Temperature & Depth) probe.
- Wiring loom complete with fully immersible watertight connectors.
- Booms as required. Novel design specified under IEC 61400:12 guidelines, optimised for low mass, simple installation and easy maintenance.
- Navigational aids.
- Aircraft warning lights (Ocean Met-M only)
- Fog horns.
- Lightning surge protection.
**Ocean Delivery Partners**

**Natural Power**

Natural Power delivers holistic offshore services to clients providing a one-stop-shop for full lifecycle wind project development. With over 250 renewable energy experts and a decade of practical experience in designing, permitting, constructing and operating wind projects worldwide, our experience provides companies interested in exploring and exploiting renewable energy sites with a comprehensive, proven solution and a unique experienced-based insight that few others can match. Within the team, over 40 individuals are presently involved with offshore wind project development activities.

**Solar Wheel**

Working within renewable energy since 1980, Solar Wheel specialise in wind measurement and data recording for wind farm site assessment. Solar Wheel have many years experience of programming and installing remote data logging systems to record wind data from a range of different instruments.

**Ampair**

Ampair has been manufacturing high quality renewable energy power systems in the UK for almost forty years. Ampair wind and hydro turbines are renowned internationally for their durability in extreme environments. With nearly 30,000 systems sold to date, Ampair turbines and hybrid power systems are currently providing power to equipment in virtually every country and ocean on the globe. From Alaska to the Antarctic, the Solent to the Sahara, you will find Ampair turbines and hybrid power systems providing trouble-free power.

Ampair are frequently selected for harsh weather locations, such as for oilfield and pipeline relay stations in Alaska, by Cable and Wireless in the Falklands, by British Antarctic Survey and the USGS for polar research, and by utilities such as Shell, ConocoPhillips, SSE, Vattenfall or Pacific Gas & Electric, as well as private individuals and government agencies worldwide. All Ampair turbines are marine grade and are manufactured by Ampair in the UK.
Costs and Leasing

Xanthus Energy can offer you a fully functional Ocean Met-M meteorological mast 100m above sea level offshore in water of depths from 60m up to 200m for circa £4M including comprehensive monitoring equipment; and that’s installed and transmitting!

Ocean Met-L is an even more attractive price since it is a much simpler structure and involves little offshore configuration and setup. The baseline price for Ocean Met is circa £2M.

Not only can we install and commission for such nominal sums, but using only standard tugs we can also move and redeploy both Ocean Met systems as many times as you like with no legacy impact and at a fraction of the original purchase outlay each time, giving you flexibility as well as huge savings.

Xanthus Energy is so confident of the ability of our products that we would be happy to discuss simply leasing them to you for fixed term packages on a full data supply basis thereby not only reducing your costs, but also removing all the capital expenditure and logistical problems you normally face in gathering information for your wind farm, leaving you free to plan your core business based upon the data Ocean Met and Ocean supplies to you.

For further information on a full service and monitoring leasing package;

Please Telephone: +44 (0)1291 40 80 88 or Email: enquiry@oceanresource.co.uk
About Ocean Energy and Resource Ltd. (Ocean)

Over the past forty years we have gained unsurpassed experience in subsea and ocean engineering worldwide, providing a wide range of complex and innovative engineering to the offshore petrochemical, energy and defence industries building, installing, maintaining and operating these systems on a turnkey basis.

Ocean understand the issues in building offshore wind farms and know that the designs offered on these pages when utilised will completely re-write the accepted economics of developing, commissioning and operating a wind farm.

We offer simple innovative and radical solutions to the complex issues involved, driving maximum cost efficiency in construction, servicing, maintenance and ultimately disposal.

The purpose of Ocean is to completely re-engineer the economics of offshore wind energy.

Ocean’s products have the potential to generate enormous additional profits for the power companies that deploy them because in the first instance they drastically reduce the installation and near term costs of establishing wind farms.

Ocean understands that offshore wind energy quickly needs profitability without subsidy to garner public support and be fully sustainable.

Ocean products will also generate and deliver their generated power far more cost effectively over the medium and long terms, prolonging the useful life and ongoing viability through much cheaper servicing and maintenance, thus ensuring that the operator, consumer and taxpayer receives the best possible value and maximum sustainability of supply.

Re-Engineering the Economics of Offshore Wind!

Telephone: +44 (0)1291 40 80 88   Email: enquiry@oceanresource.co.uk

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