



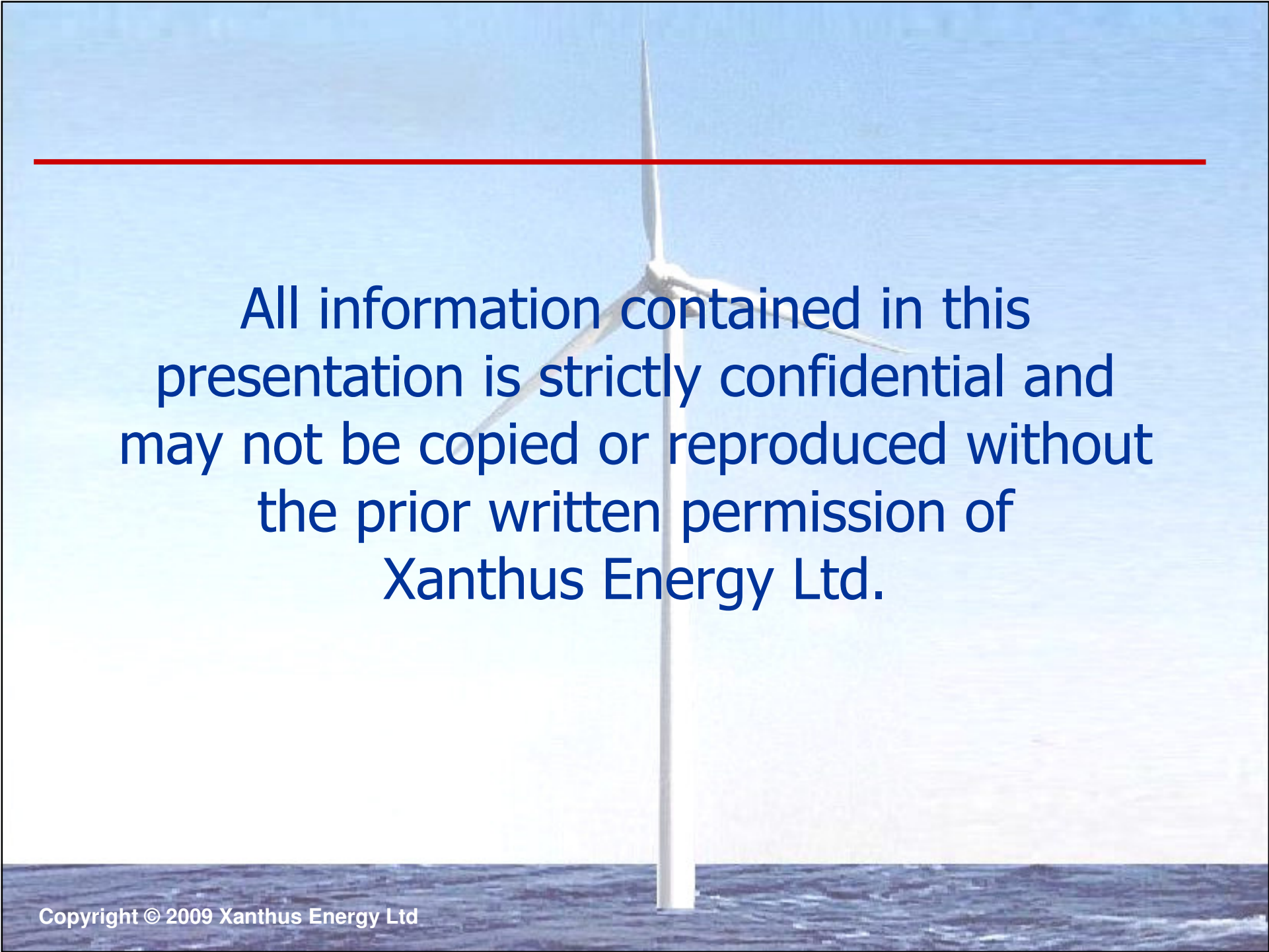
SeaBreeze©

Putting Offshore Wind on a Firmer Foundation

SeaBreeze Technology – Reducing Project Cost and Risk

Presented by

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About Xanthus Energy Ltd

Our Vision:

To **Enable** the development of large scale “Farshore”
Wind Energy Resources

Our Focus:

To develop Cost Effective and Environmentally-
acceptable “Farshore” wind turbine foundation systems
using:

Innovative, Proven Technology
Purpose Design and Optimisation
Efficient Manufacturing
Self-installing Technology



Our Background

Offshore & Specialist Engineering Skills ...

Project Identification

Conceptual Engineering

Buoy Systems Design

Floating Structures

Autonomous Operations

Marginal Production Platforms

Submarine Cable Engineering

Foundation Design

Electrical Power Systems

**Wind Turbine Fatigue &
Dynamics**

Materials Technology

Hydrodynamics

Stress Analysis & FEA

Project Coordination



Some examples of our previous design,
build and install offshore projects

Relevant Technologies

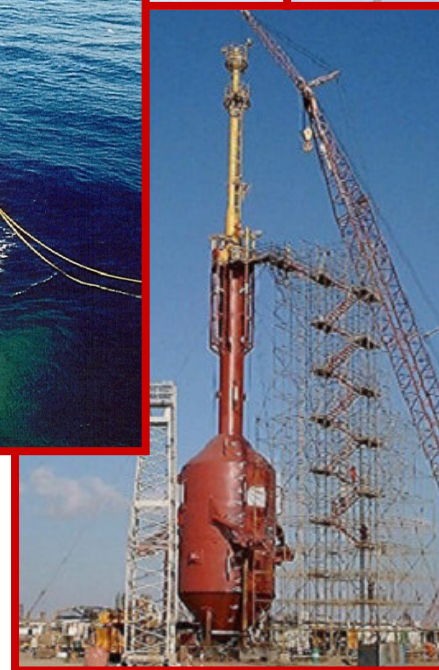
Concrete Gravity Base



East Spar Buoy



Sea Nova Platform



Sea Commander Buoy



Onshore Wind Turbine

Why Go into Deeper Water?

“The Far-shore”

- Inshore waves are peakier, more frequent & damaging
- Poor and Unsafe Access in shallow water
- Limited Number of “Sandbank” Sites (Inflexibility)
- Wind Farm Scale Limitations inshore
- Misconception of Costs and Problems involved in deeper water installations
- Reduce conflict with Other Users and Interest Groups (SEA)
- Increasingly Poor Public Perception inshore

Sea Breeze[©]

- **Our patented offshore wind turbine foundation systems ...2 versions:**
 - **SeaBreeze: Fixed** – shallow water up to 60 metres
 - **SeaBreeze: Floating** – deeper water, 60 to 200 metres and beyond
 - **Optimised** for offshore wind turbine lifecycle cost, weight, durability and any size of WTG
 - **Based on proven, operating technology**

Sea Breeze[©] - Design Drivers

- **Low Installed Cost**
- **Design Functionality**
- **Durability**
- **Low Cost Maintenance and Operation**
- **Minimal Visual Intrusion**
- **Economic Removal**
- **Location Flexibility (i.e. seabed conditions and water depth)**

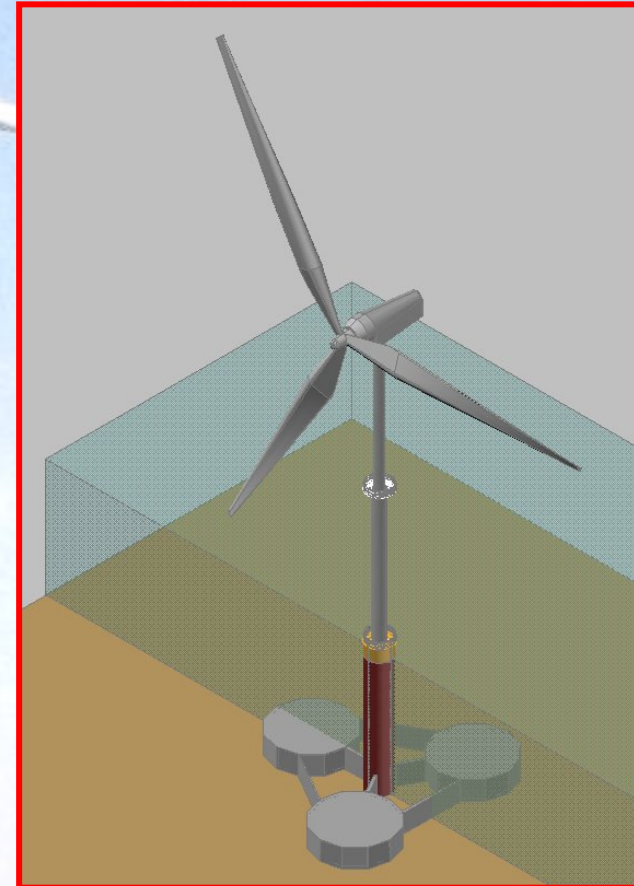
Sea Breeze: Fixed[©]

- Enabling Methodology

- **Fit-for-Purpose Design**
- **Material Selection for Optimum Performance**
- **Prefabrication using Repeat Formwork**
- **Inshore Installation of Turbine and Blades**
- **Inshore Commissioning and Testing**
- **Typically no Seabed Preparation**
- **Buoyant structure - No Specialised Vessels needed for Installation**

Sea Breeze: Fixed[©]

- Self Installing
- Seabed Founded
- Gravity Base
- Prefabricated
- Telescopic Tower option



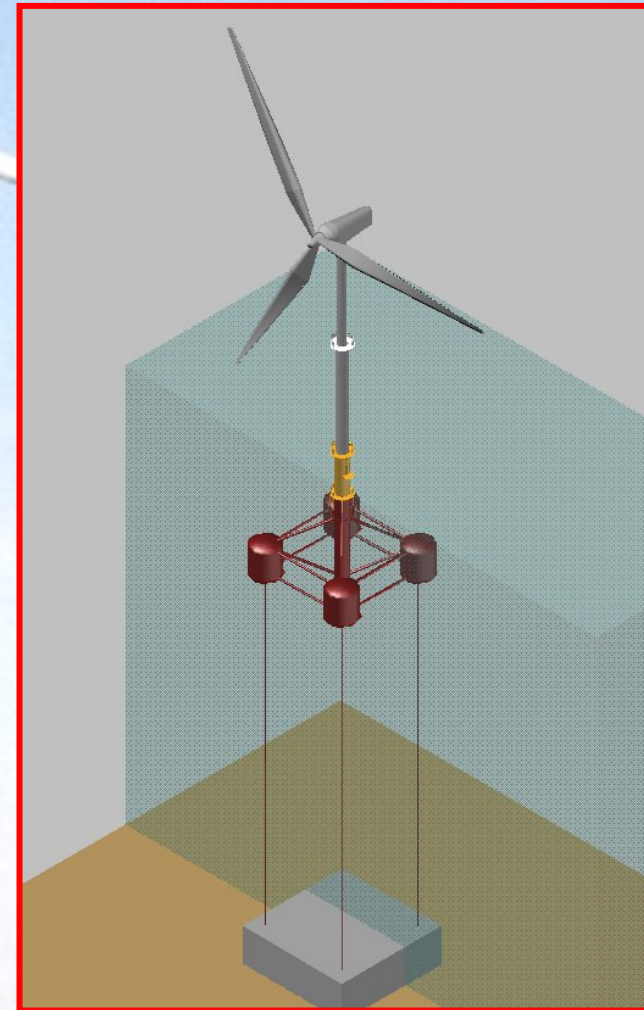
Sea Breeze: Fixed[©]

- Development Status

- IP and Patenting - Complete
- Preliminary Design - Complete
- Hydrodynamic Analysis - Complete
- Model Testing - Complete
- Cost Analysis and Verification - Complete
- Independent Technical Verification - Complete
- Detailed Design – to suit turbine configuration

Sea Breeze[©] Floating

- Self Installed
- Floating Structure
- Gravity Anchored
- Prefabricated
- Telescopic Tower option



Typical Configuration

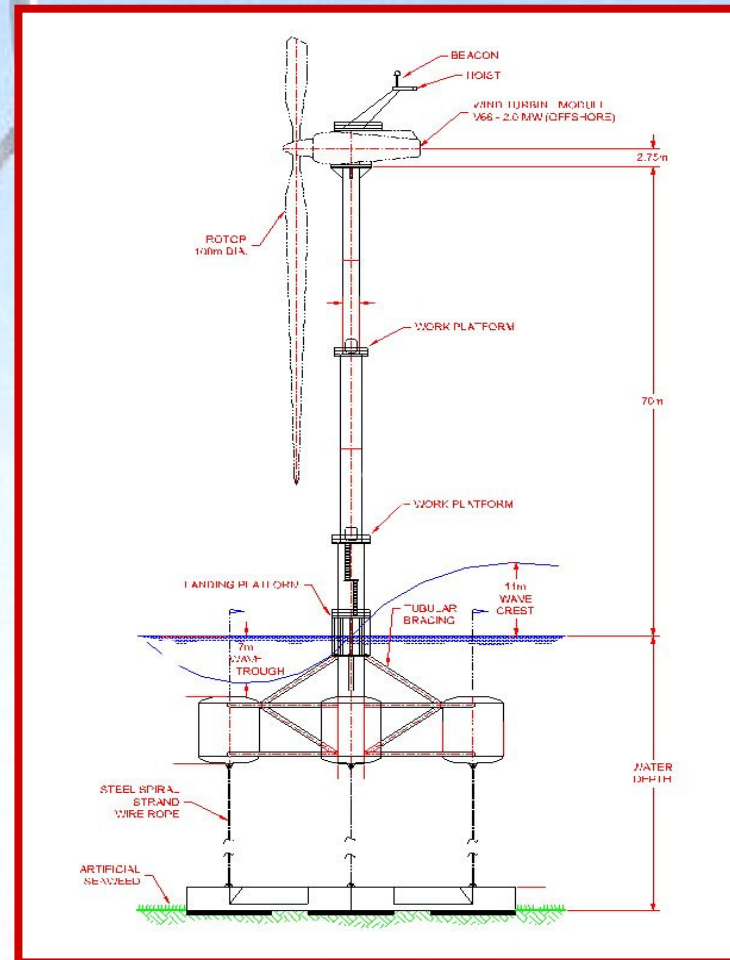
Approx. Dimensions

Nascelle Ht. - 72.75m

Rotor \varnothing - 90 – 100m

Water Depth - 50 m plus

Wave Height - 20m



Sea Breeze[©] - Outline Specification

Floating Structure

Steel Weight 702 tonnes

Overall Diameter 40.5 metres

Tower Height (above MSL) 72.75 metres

Operating Draft 20 metres

Buoyant Chamber Ø 8 metres

Gravity Base Structure

Overall Dimensions 44m x 44m x 3.5m

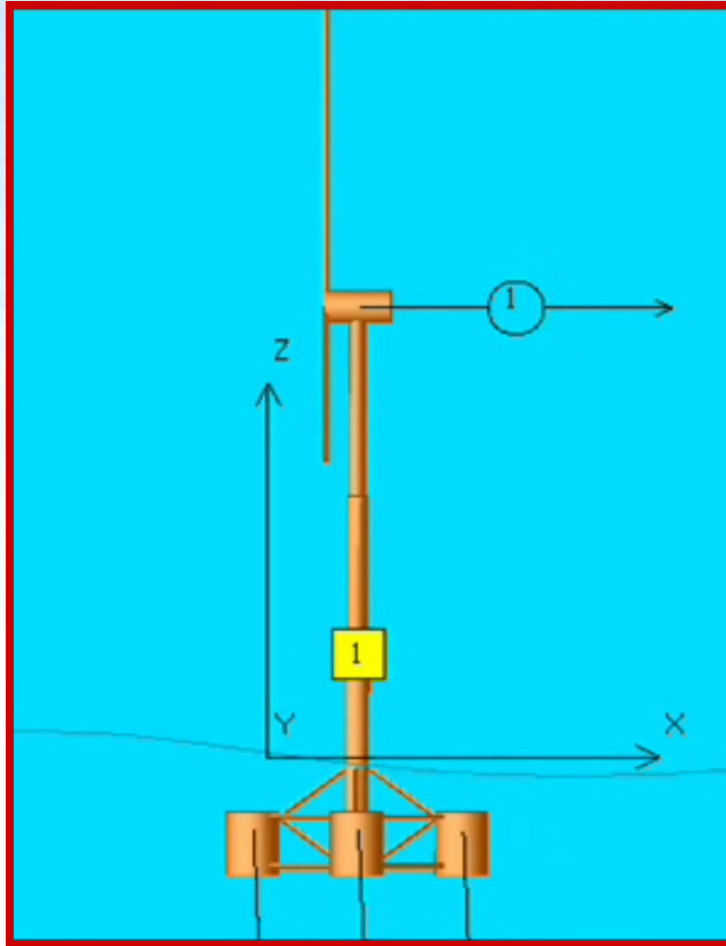
Weight 2000 tonnes approx.

Tether System

Each Outrigger - Multiple Galvanised Wire Ropes

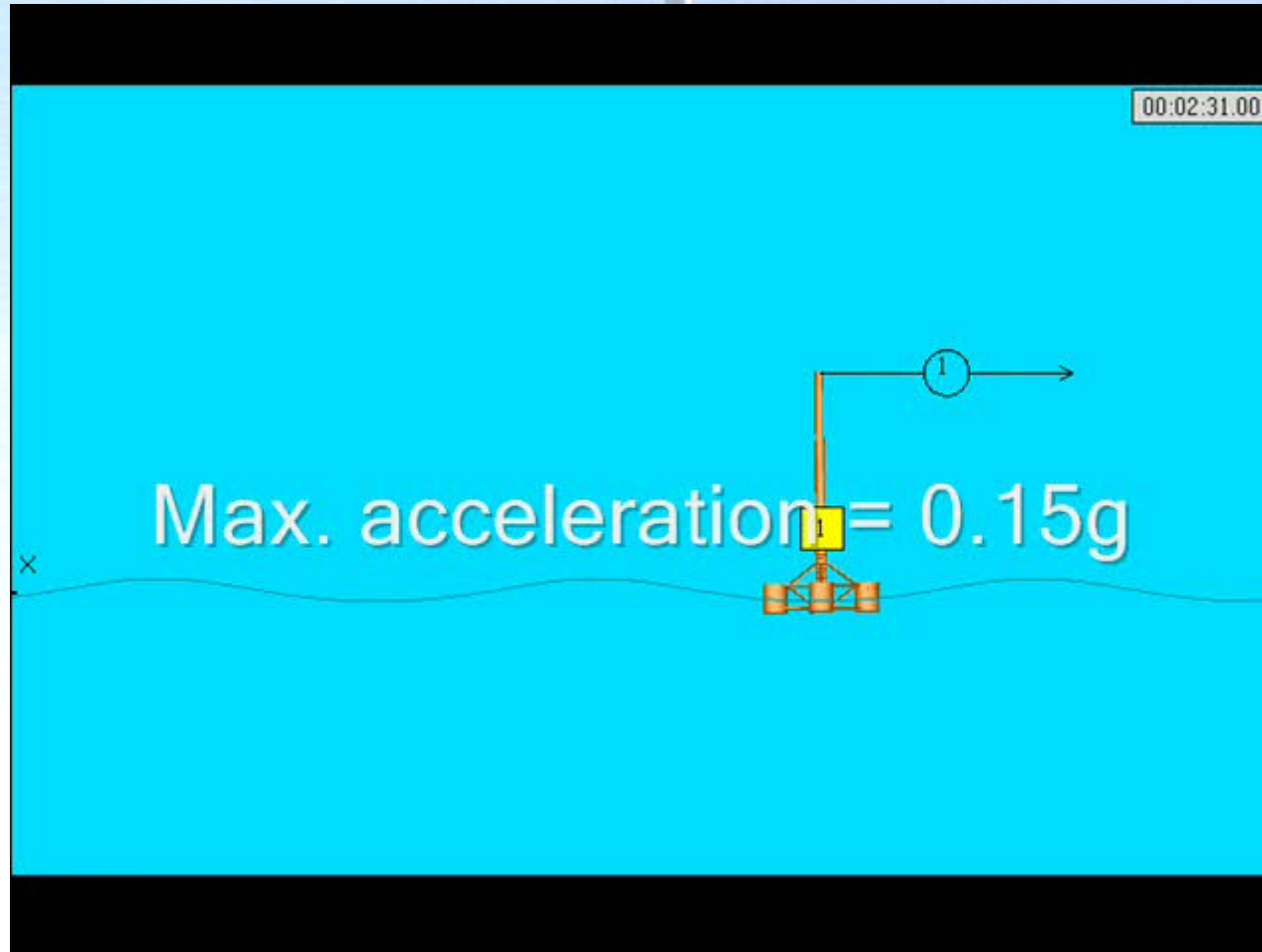
UBS 1200 tonnes per tether assembly

Hydrodynamics Analysis

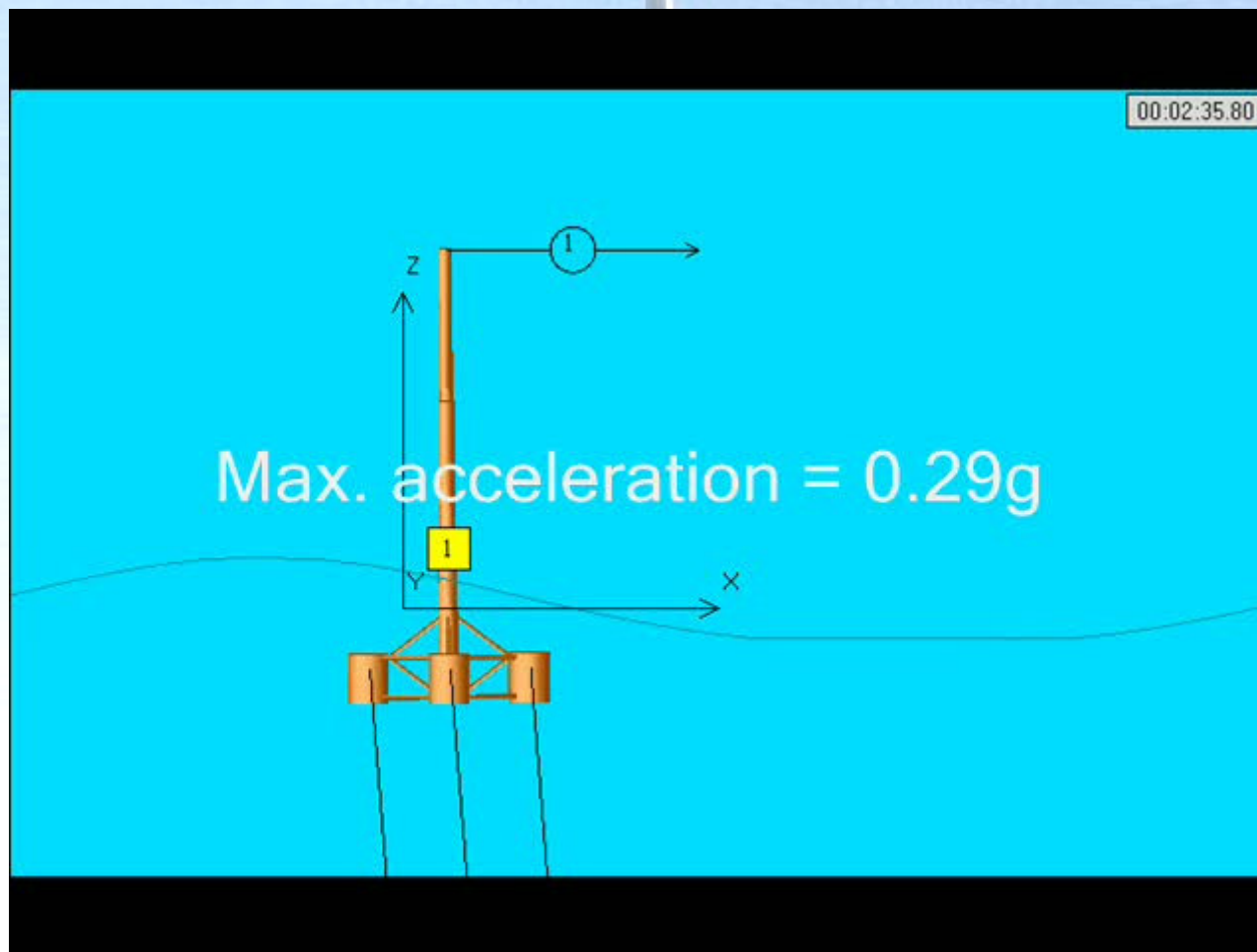


- ✓ Proven ANSYS AQWA Software
- ✓ fully validated using
 - extensive model testing
 - in-field measurements
 - externally and by ourselves
- ✓ Our sister company, Ocean Resource, has 15 years experience in its application
- ✓ Our expertise in the analysis of this type of structure is unparalleled.

Sea Breeze© - Tow 8m Sig. - 4 kts



Sea Breeze© - Survival 18 m max.



Sea Breeze[©] Floating

- Performance Criteria

- **Economic in water depths of around 50-200 metres and beyond.**
- **70 metres turbine operating level (typical)**
- **Minimises seabed selection foundation problems**
- **Located some distance offshore to eliminate visual intrusion and planning concerns**
- **No dependence on often fragile or sensitive offshore features (e.g. Sandbanks)**
- **Wave Forces and Scour will be less on the base structure**
- **Generally no Seabed Preparation,**
- **Low Capex and Opex, Easy removal and re-use**
- **Cost effective in very deep water**

Model Test at Cork University

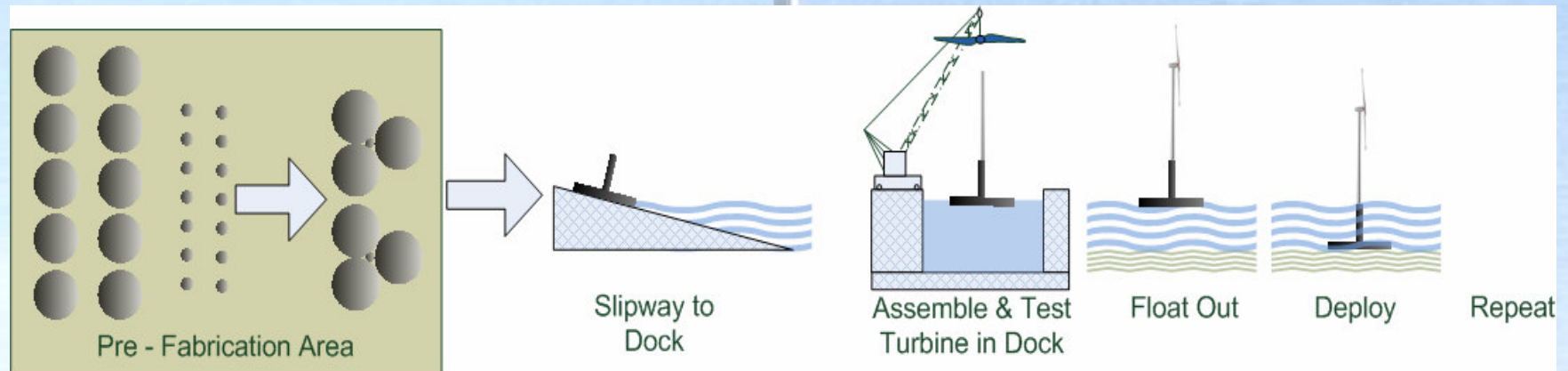




Sea Breeze[©]

**Manufacturing
Overview**

Production Process (Typical)



- **How much more simple it can be...**
- **Install and commission on land – reducing cost**
- **12 hrs deploy using standard tugs no weather risk**
- **Dramatically reducing cost, timescales and risk**

Manufacture & Installation

- Concrete bases fabricated by glued segmental construction or slip formed – we have experience of both
- Foundations built in production line setup for mass production onshore close to wind farm site
- Needs only 6-7 metres for launch
- Fit-out of Tower, Nascelles and Blades **In-shore**
- Commissioning and Testing **In-shore**
- Completed Units can be stored In-shore as Floating Units
- No Specialised Vessels for Installation

Manufacture & Installation

Slip-way Launch and Prefabrication techniques already used for Missile Development Platforms for Irish Sea Deployment

Platform payload - 200 tonnes

Water Depth - 20 metres

Temporary Drydock established

Rail Launch into Irish Sea

Beach Reinstated.



A photograph of a white offshore wind turbine standing in the ocean under a clear blue sky. A horizontal red line is drawn across the upper portion of the image.

SeaBreeze[©]

**Offshore Wind Farm
Risk and Cost Reductions**

Sea Breeze[©] Risk Reduction

- **Dockside assembly and Commissioning**
 - 24 hour availability to work site - easy access
 - Land based lift and tools : low cost, high availability, controlled environment
 - Commission and test onshore : reduced cost of failures, fixability
- **Installation**
 - No risk of heavy lift vessel cost overruns due to bad weather
 - reduction of high risk assembly activities offshore
 - smaller offshore team ... lower cost (typically Oil & Gas offshore labour costs 4 x onshore costs)
 - quicker installation

More Rapid Project Cash Generation!

Sea Breeze[©] Cost Reductions

- **Installation**

- Generally no seabed preparation and no piling
- One trip installation
- No special vessels for installation : 3 standard tugs, uses buoyant structure to support weight
- Typical vessel costs reduced from £250,000 to £30,000 per day
- Rapid deployment : <12 hours complete install
- Use of shorter weather windows : higher installation efficiency and lower slack time costs
- Total installation cost (2007 DTI report) reduced from £500,000 to £50,000

Sea Breeze[©] Cost Reductions

- **Operation and Maintenance (O&M)**
 - Jacking tower (if installed) allows lowering for removal/maintenance of nacelle/blades (hence reduced costs)
 - Complete removal is a simple reverse of installation (small decommissioning cost)
 - Easy removal permits major repair/upgrade onshore
 - All other costs comparable

Sea Breeze[©] Cost Reductions

What is the impact on the price of electricity?

**€10 / MWH
lower**



Sea Breeze[©]

**Technical
Overview**

Levelling & Seabed Preparation

- Patented foundation techniques for varying seabed conditions and levelling
- Vertical alignment adjustment is also possible at tower joint
- Use of a skirt for certain seabed conditions when required
- Low cost scour protection system can be fitted if needed (typically not required)

In General - No Sea Bed Preparation

Power Electrical Details

- Flared or flanged J or I tube built into base of buoy or concrete base
- Split flange above LAT to make watertight seal
- Expertise in cooling electrical equipment in enclosed spaces in marine environments
- Opportunity to place electrical power equipment in base of structure
 - reducing nacelle weight
 - providing easier access

Telescopic Tower Details

- **Optional where installation or service requirements dictate**
- **Locking joints based on proven methods of assembly – low stress/fatigue**
- **Joints designed for positive locking**
- **Proven Jacking process - used on other products**
- **Practical expertise in these systems**



Supporting Wind Power Offshore

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