



**CATAPULT**  
Offshore Renewable Energy

## Levenmouth research wind turbine data

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Supergen Wind General Assembly

26<sup>th</sup> May 2016

We work with  
**Innovate UK**

## ORE Catapult's 7MW Offshore Wind Turbine

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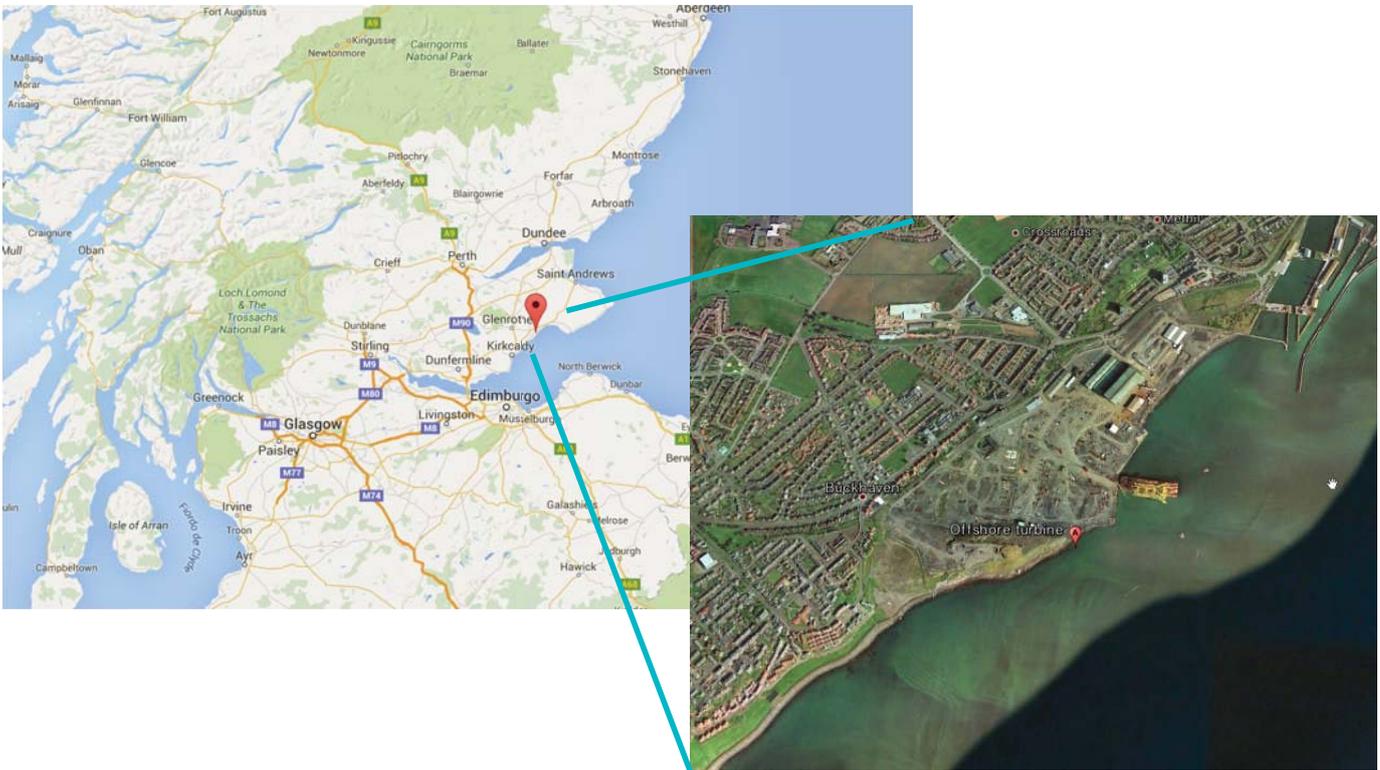


Closing the loop on Laboratory Testing

- Ownership of 7MW Turbine
- Installed in Scotland in 2013



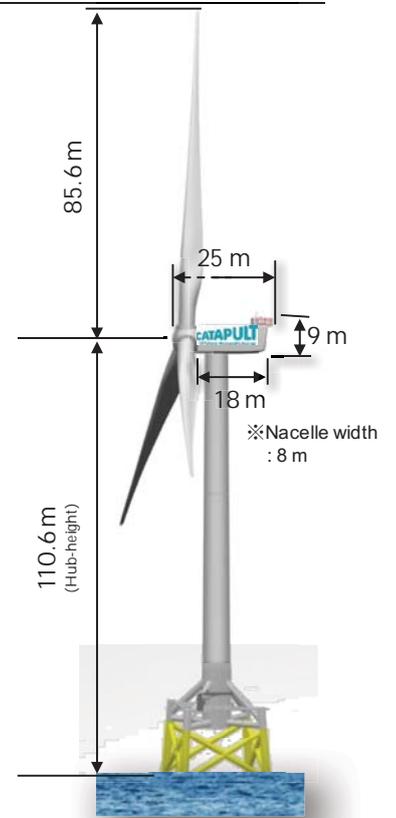
# Location



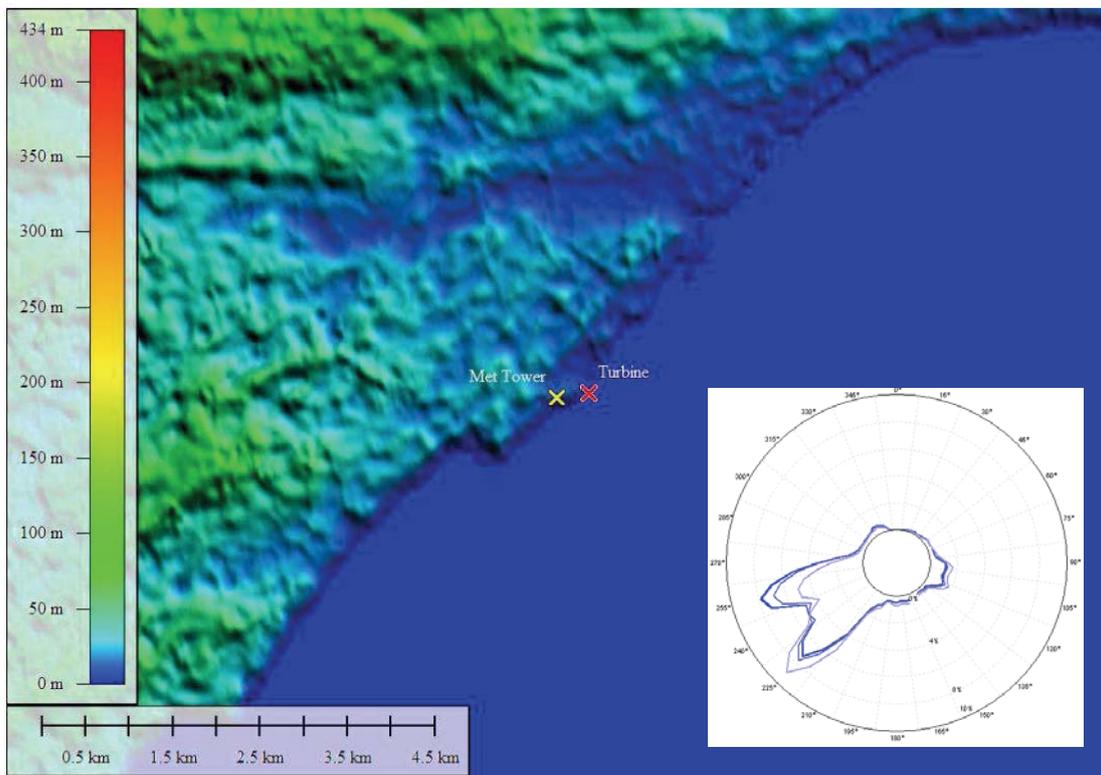
# Catapult Levenmouth 7 MW Demonstration Turbine



<b>Wind Class</b>		IEC Class 1a	<b>Rotor dia.</b>		171.2m
<b>Capacity</b>		7MW at grid side	<b>Hub height</b>		110.6m
<b>Generator</b>		Medium (3.3kV), PMG	<b>Converter</b>		Full power conversion
<b>Drive train</b>		Medium speed (400rpm)	<b>Rated frequency</b>		50/60Hz
<b>Rotor speed</b>		5.9 ~10.6 rpm	<b>Wind speed</b>		3.5 ~ 25 m/s
<b>Temp range</b>	<b>Survival</b>	-20°C to +50°C	<b>Humidity (relative)</b>	<b>Blade</b>	100%
	<b>Operating (site specific)</b>	-10°C to +25°C -10°C to +35°C		<b>Nacelle</b>	Inside : < 50 % (with dehumidifier) Outside : 95 %
<b>Lightning protection level</b>		Level 1 (IEC 62305-1)	<b>Corrosion Category (ISO 12944-5)</b>		Inside : C4 Outside : C5-M
<b>Design life</b>		25 years	<b>Certification</b>		DNV



# Site Characteristics



## Wind

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- 4x Thies Class 1 Anemometers
- 2x Wind Vanes
- 2x Temperature
- 2x Air Pressure
- Turbine Wind Speed
- Turbine Wind Direction

10 minute – min/max/mean/sd 1 Hz sampling Wind speed
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## On-site IEC Met Mast

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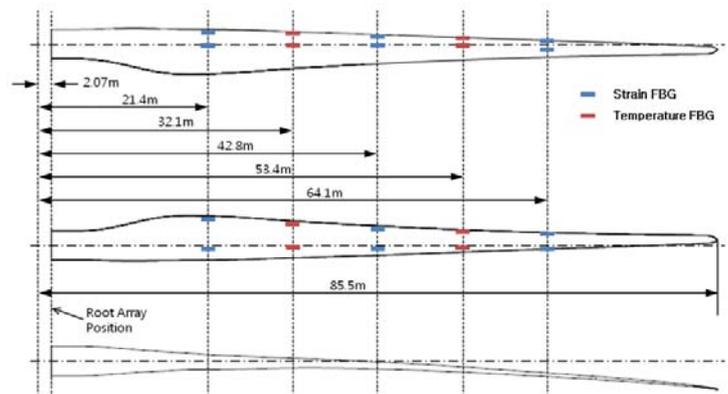
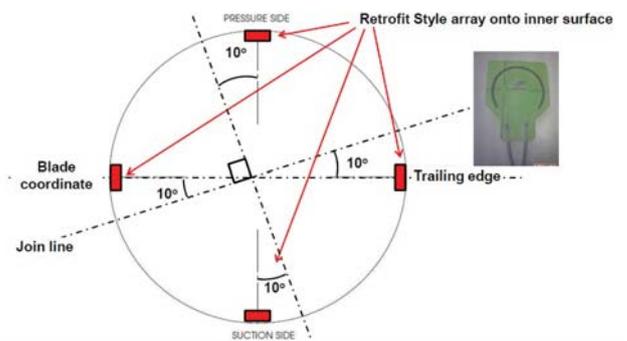
## View from the mast

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## Blades

- In each blade:
  - Edgewise moments (resolved)
  - Flapwise moments (resolved)
  - 4x Strain measurements in blade approx. 2m from root
- 1 Blade contains additional strain gauging



## Pitch System

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- For each blade:
    - Pitch position
    - Pitch rate
    - Pitch system status
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## Main Bearing

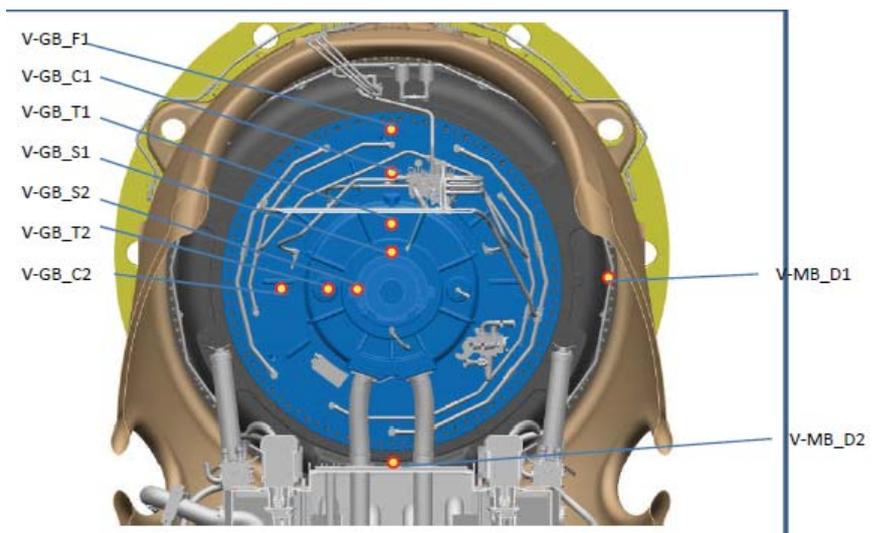
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- 2x Temperature
  - 4x Deflection sensors
  - 2x Vibration (SCADA)
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## Gearbox

- Lubrication system condition
  - Temperature
  - Oil contamination
- Shaft bearing temperatures
- Internal bearing temperatures
- Vibration sensing



## Generator

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- 3x Phase Voltage
  - 3x Phase Current
  - 4x Mounting Deflection
  - 6x Stator Temperature
  - 4x Bearing Temperature
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## Yaw System

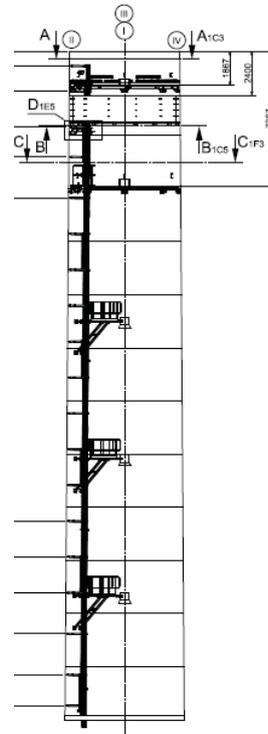
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- Work to calibrate Yaw Position against geodetic reference required before studies into Yaw Misalignment etc can be carried out.
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## Tower

- Fore/Aft Vibration at 2 levels
- Planned: Strain Gauging for loads measurement



## Power Converter

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- 3 Phase Currents and Voltages
- Power Factor
- Active & Reactive Power
- **Planned: Additional diagnostic data available from ABB onboard monitoring system**



## Medium Voltage Transformer & Grid Connection

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- Air Temperature
- Winding Temperatures
- 3x Phase Current and Voltages
- Active and Reactive Power
- Frequency
- Power Factor

