



CATAPULT
Offshore Renewable Energy

Levenmouth research wind turbine data

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Supergen Wind General Assembly

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We work with
Innovate UK

ORE Catapult's 7MW Offshore Wind Turbine

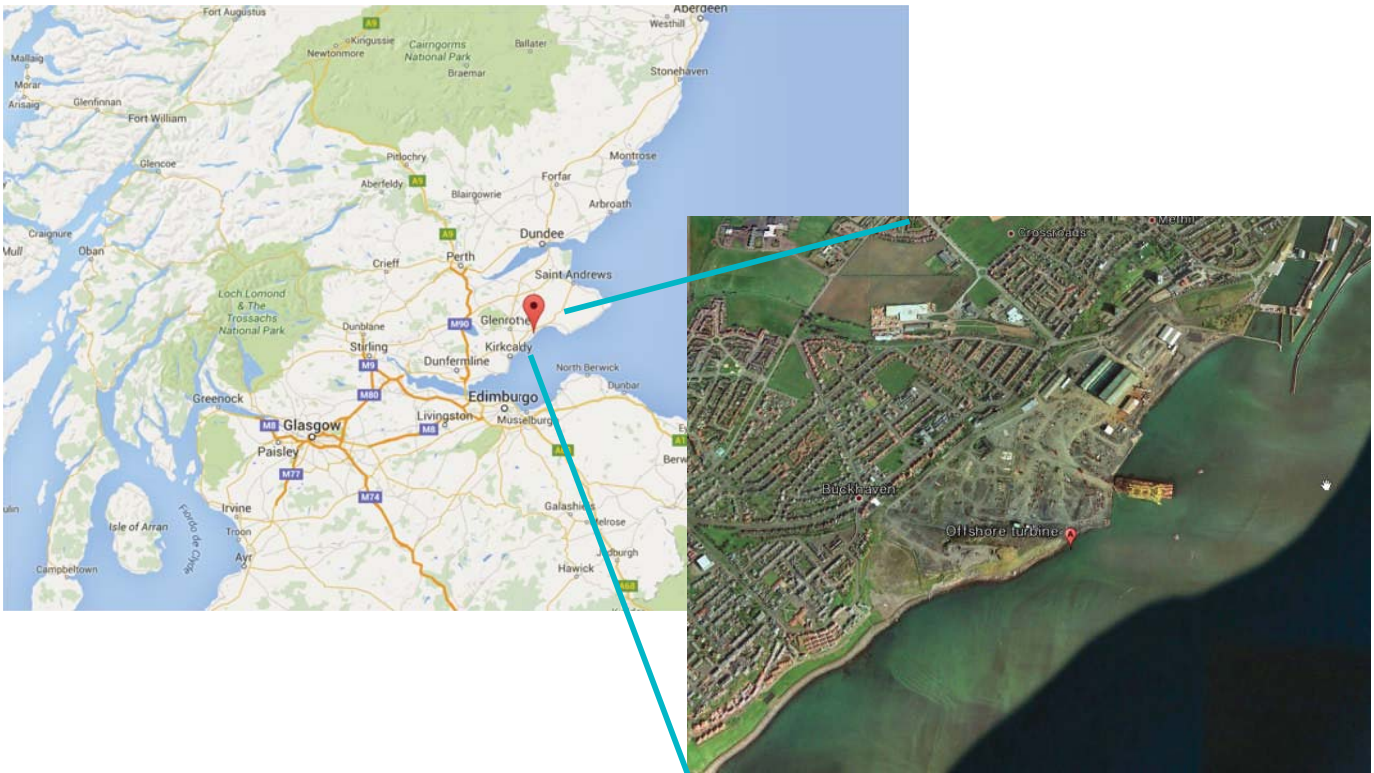


Closing the loop on Laboratory Testing

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



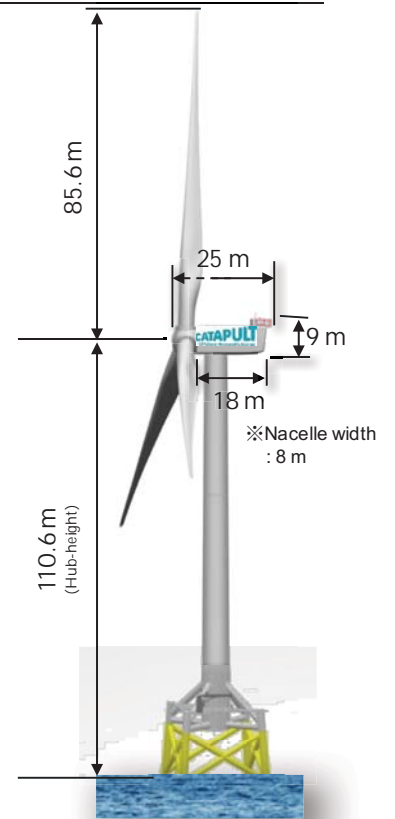
Location



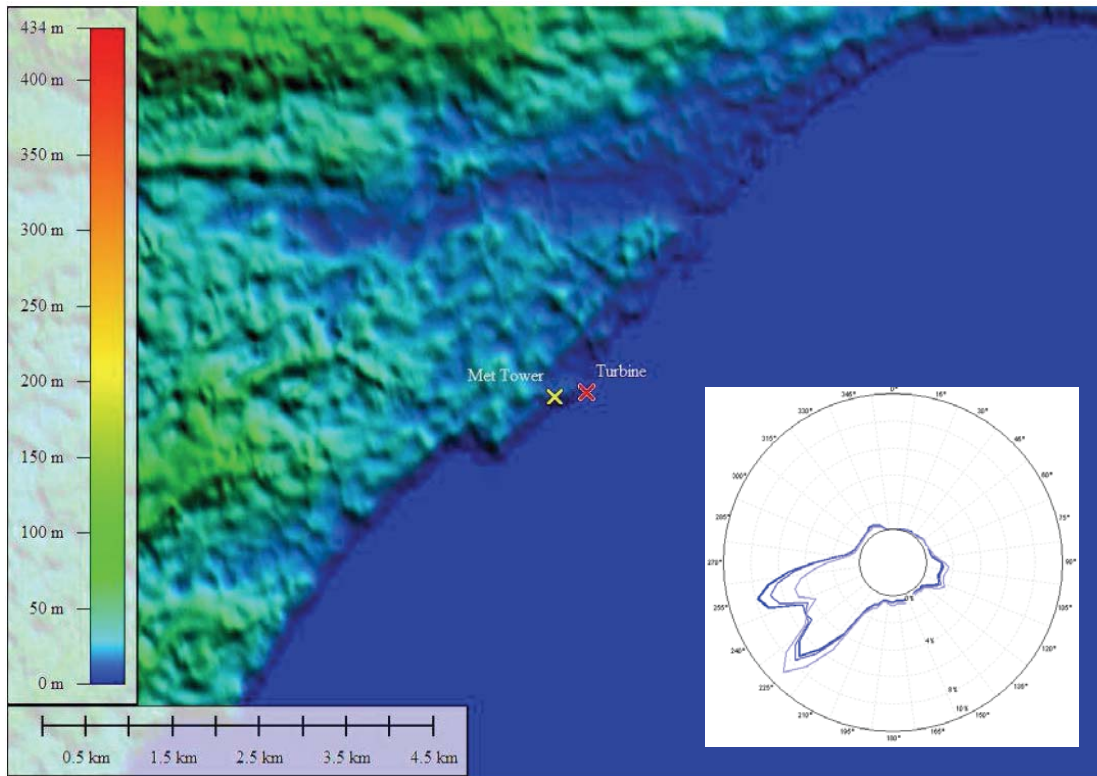
Catapult Levenmouth 7 MW Demonstration Turbine



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



Site Characteristics



Wind

- 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

On-site IEC Met Mast

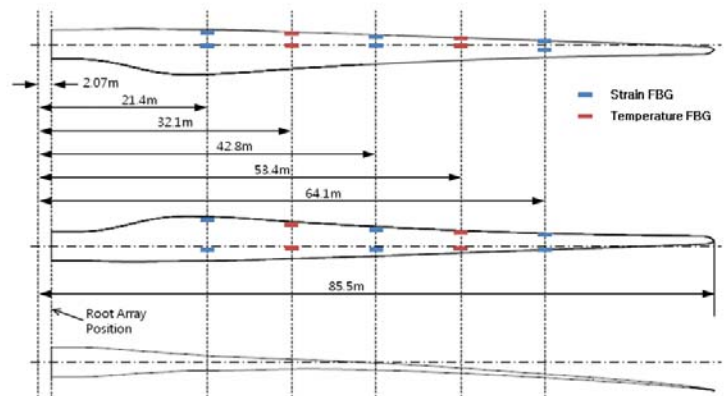
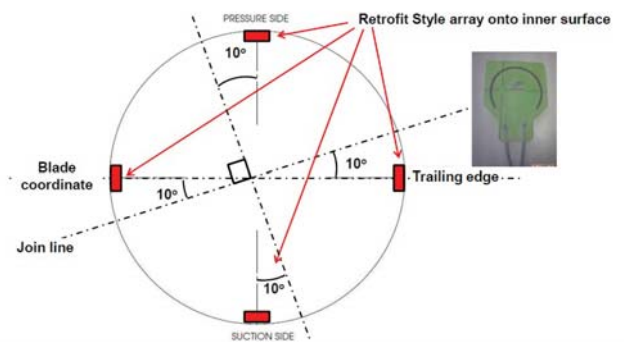


View from the mast



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



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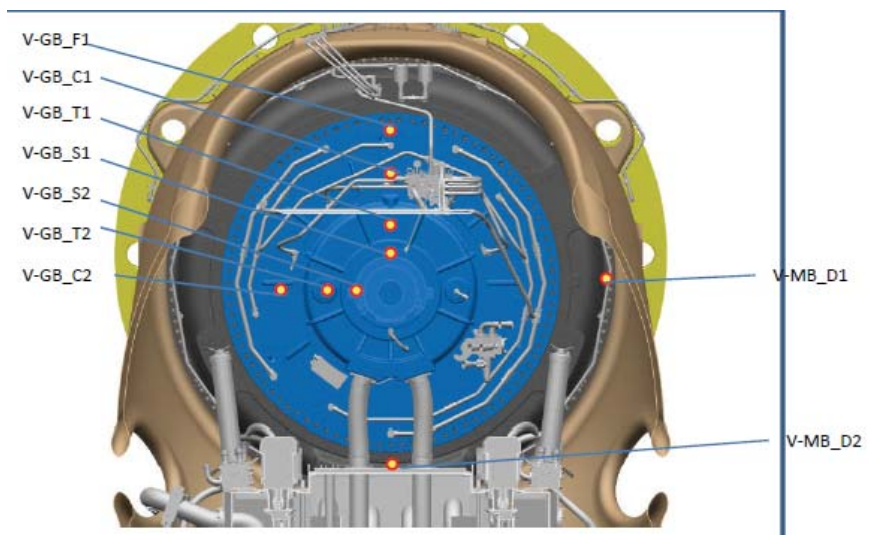
Main Bearing



- 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



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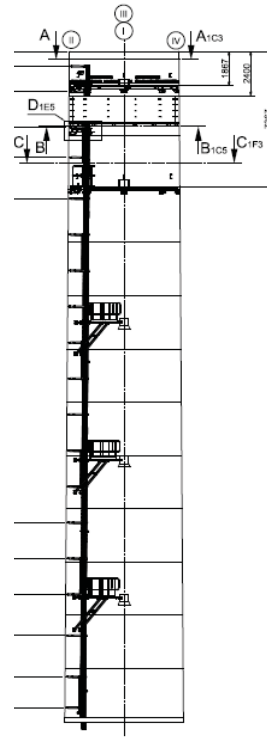
Yaw System



- 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

- 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

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

