

CATAPULT
Offshore Renewable Energy

Research, testing and demonstration

ore.catapult.org.uk
@ORECatapult

We work with
Innovate UK



Wind turbine rotor blades

Power train and components

HV electrical systems

Subsea trials and demonstrations

Resource management and assessments

Levenmouth demonstration turbine



We operate the largest concentration of multi-purpose offshore renewable energy technology test and demonstration facilities in the world.

ORE Catapult is the UK's flagship technology innovation and research centre for offshore wind, wave and tide. We help to reduce the cost of offshore renewable energy, supporting the growth of the industry and creating UK benefit.

Our facilities, along with our highly experienced multi-disciplinary team of experts and engineers, help to prove and de-risk promising new technologies and bring them to market.

Understanding and forecasting performance reliability before commercial operation is the only way to minimise uncertainty, build market confidence and reduce the levelised cost of energy.

Our facilities have been specifically designed to address the issues experienced by the industry today. We provide a controlled testing ground to support projects through all stages of development from prototype to full scale demonstration, helping to tackle the technical, logistical and commercial challenges.



Wind turbine rotor blades

Product certification, verification and investigations for the next generation of offshore wind turbines.

Our team of experts have performed extensive commercial rotor blade and research tests for leading manufacturers since the facility first opened in 2006. The facility undertakes structural testing of wind turbine blades up to 100m in length (dynamic and static) in accordance with IEC and ISO standards and customer requirements. These facilities help to prove blade design and manufacturing processes prior to installation in the field, ensuring the desired level of reliability.

As well as assisting in the certification of your product, our specialist blade delivery team, with more than 50 years collective expertise of designing and undertaking rotor blade tests, work with you to ensure you gain maximum benefit from the test. This allows you to learn and harvest critical structural behaviour data as well as assessing the set-up and performance of different sensors and sub-systems.

The facilities can be operated 24/7 and are accredited to ISO17025 by The United Kingdom Accreditation Service (UKAS).



Testing services

- Determination of natural frequencies
- Modal analysis
- Static test
- Fatigue test
- Post-fatigue test
- Collapse test

Additional services

- Structural failure investigation
- Bespoke component structural testing
- Effect of damage and repair methods
- Characterisation of bend-twist coupling
- Test design
- Development and testing of blade sub-systems: structural health monitoring, ice prevention systems and add-ons.
- R&D projects in bi-axial testing, blade erosion and condition monitoring
- Blade design engineering (aeroelasticity, structural and aerodynamics)
- SME product development support



EUROPEAN UNION
Investing in Your Future
European Regional
Development Fund 2007-13



2769
Accredited to
ISO/IEC 17025:2005

“Building a UK supply chain is essential for the development of UK manufacturing in the offshore renewable energy sector. Catapult’s strategy to drive innovation into the industry is a fundamental enabler to achieving this.”

Siemens

Power train and components

Independent nacelle testing facility for complete systems and components.

Our 3MW and 15MW power train testing facilities are capable of performing independent performance and reliability appraisals of full systems and components (including the main bearing, gearbox, generator and converter). Both test rigs use a Non-Torque Loading (NTL) system to perform accelerated lifetime testing in a full scale, controlled onshore environment. The NTL system applies the typical and extreme forces and moments that the environment will exert on the power train of a device in service.

Our 3MW and 15MW test rigs help to improve the understanding of turbine performance, identifying any potential assembly and design issues in a relatively short time period compared to field tests. Ultimately reducing the technical and commercial risk of deployment.

Our 3MW facility, operational since 2012, has been used to test a number of tidal turbines and wind turbine components.



Testing services

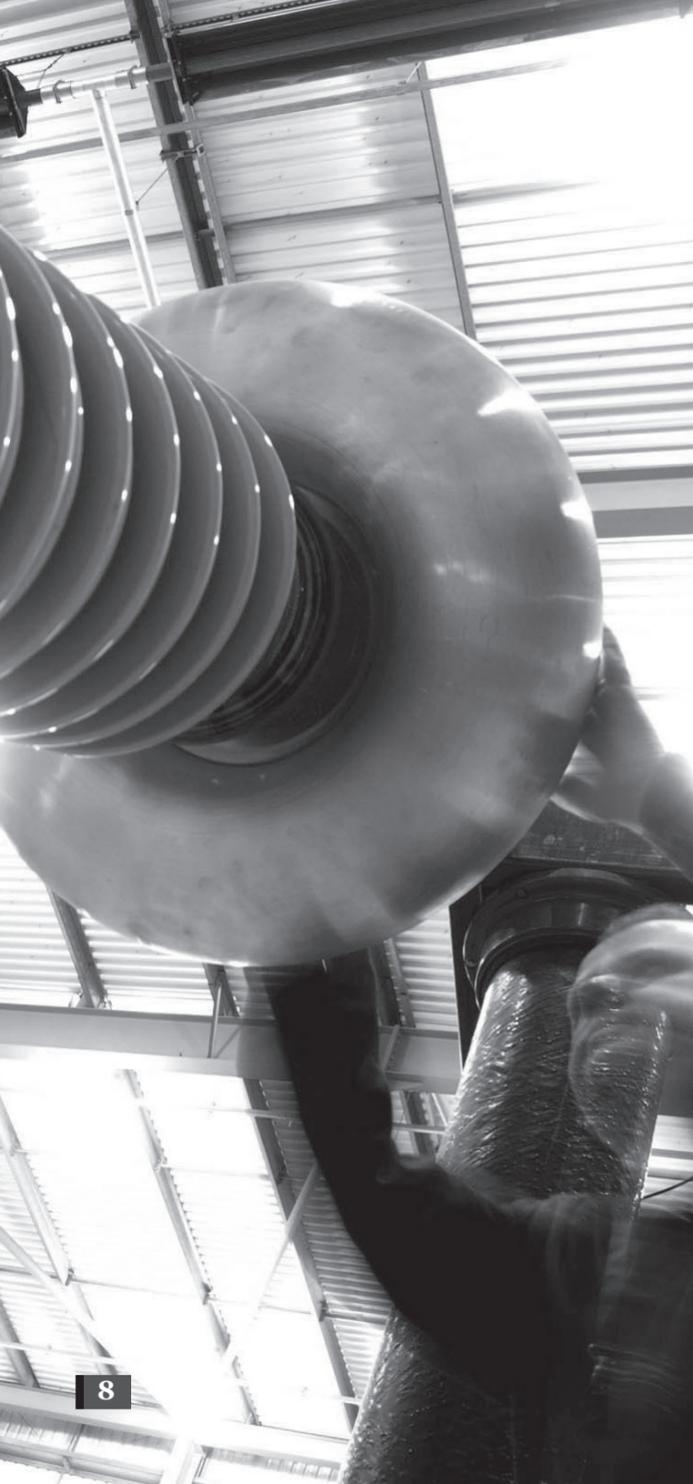
- Endurance and extreme load tests, including Highly Accelerated Lifetime Testing (HALT) with multi-axis loading
- System performance tests, including power curve and efficiency assessments and control system verification
- Design verification and validation
- Component validation and conformance testing (gearbox, generator and bearing)
- New supplier validation test (major component)
- Improvements to physical and numerical models – condition monitoring validation

Additional Services

- Optimise test programme, including measurement campaign design and test load profile design
- Mechanical interface and support structure design and procurement
- Data - post processing to assess design with test results
- Tear down inspection for failure investigation
- Installation and decommissioning support
- Instrumentation design and set-up
- Mechanical and electrical design
- Data verification and analysis
- Component life cycle analysis
- Collaborative R&D projects and SME product development support

Testing at ORE Catapult is an important step in our engineering process and the data collected will play a critical role in future design considerations. We plan to continue to invest in both onshore and offshore testing.”

Atlantis Resources Limited



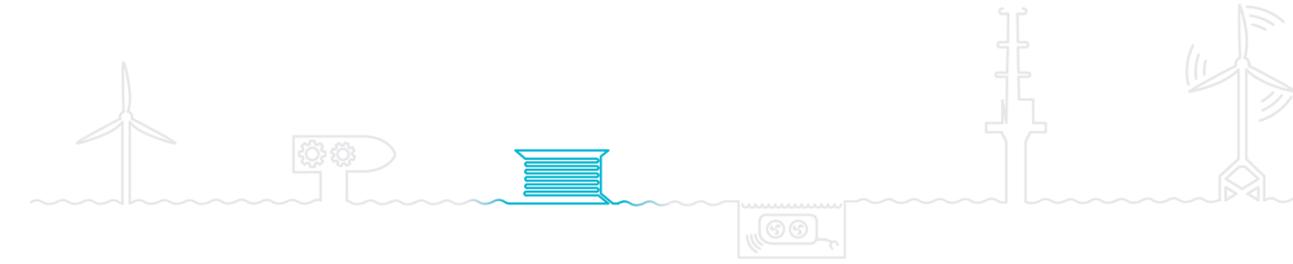
HV electrical systems

Established test and certification partner with accredited facilities for electrical, materials, mechanical and environmental testing.

Our UKAS accredited laboratories are equipped with an extensive suite of specialist test and measurement facilities, helping clients to develop technologies to cater for the needs of the developing power systems and exploring life extension opportunities for ageing assets.

Specific emphasis is placed on component development, materials selection, system certification, electrical grid integration and accelerated lifetime test programme delivery, helping to improve component reliability and ensure complex multiple arrays and generation sources operate at optimum efficiency.

The laboratories are the only UK accredited facilities for the testing of power cable systems, capable of providing type testing services for underground and submarine cable systems. They are ideally located next to our subsea testing environment allowing us to undertake saltwater immersion for trialling of electrical equipment and systems.



Testing services

- Type certification of HV cable systems, switchgear and other HV insulation systems
- Cable accessories (joints, splices, connectors) integrity and type testing
- HV and insulation breakdown testing up to 600kV AC, 1MV DC.
- Product development, testing and certification support
- HV bushing and transformer performance testing
- Accelerated ageing testing, including live environmental, mechanical and electrical stresses
- Materials and coatings selection, testing investigations, salt water corrosion and oil analysis
- Environmental assessment and testing
- Temperature and process data telemetry

Additional services

- Fault finding, failure investigation and diagnostics of cable accessories and bushings
- Static and fatigue cable testing
- Cable installation and pull-in trialling
- Field services
- Power systems consultancy
- Polymeric materials testing
- Feasibility and market studies
- Collaborative R&D projects and SME product development support



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ISO/IEC 17025:2005

“ORE Catapult’s focus on developing standards, certification and reliability for the offshore renewable industry will directly help to improve performance from our existing plants and drive down the cost of energy from offshore wind.”

SSE



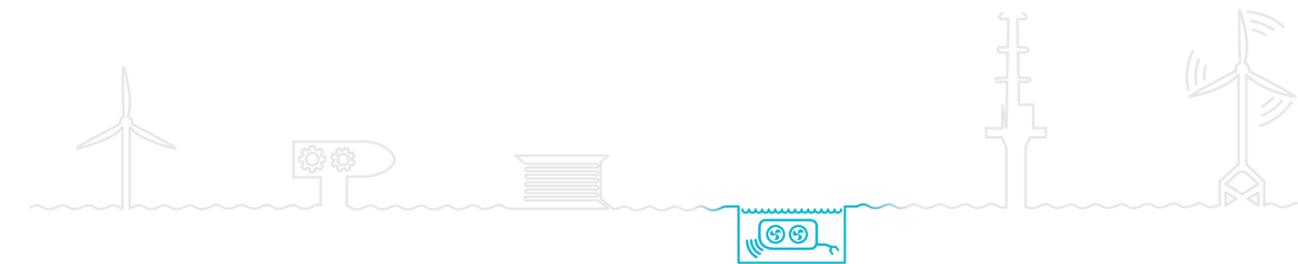
Subsea trials and demonstrations

A flexible and controlled onshore saltwater location for all stages of technology development.

The open access shallow water testing facilities, which have been used for testing subsea equipment since 2002, contain an artificial seabed and two still water test tanks (up to 8m in depth). The controlled salt water environment is used to trial and demonstrate new and innovative technologies and for practicing installation techniques at full scale. This real-life testing ground helps to reduce the risk of failure when bringing innovative technologies to the market without the need to go offshore.

Large scale industrial pumps are used to fill and drain the tanks which provides the flexibility for testing equipment to be installed and modified in the dry.

This facility also complements our HV electrical laboratory, allowing us to complete both mechanical and electrical testing of subsea components and whole systems.



Testing services

- Cable protection systems and cable laying equipment demonstration trials, including ploughs and trenching systems
- Prototype subsea equipment deployment and factory acceptance trials
- Scaled foundation testing, including piling techniques, noise mitigation and anchoring
- Hydrodynamic stability analysis and testing
- Wave energy extraction power take-off design evaluation and testing, including electrical systems
- Subsea survey/inspection equipment demonstration and calibration

Additional services

- Complete test project management
- Test data collection and analysis including installation of sensors and data acquisition systems
- Test set-up and design
- Mechanical and electrical engineering support
- Design and implementation of control systems
- New concept appraisals
- Technology due diligence
- Collaborative R&D projects and SME product development support

“Developing and proving our products prior to field installation is a key component in maintaining our leadership. Having the ability to access ORE Catapult’s high quality facilities gives us a unique industrial advantage.”

Tekmar Energy Ltd



Resource measurement and assessment

Open access facility for testing, calibrating and verifying remote sensor technologies.

The open access offshore anemometry platform is located in representative Round 3 conditions, 3nm off Blyth, Northumberland. It provides high quality wind resource and environmental data enabling developers and manufacturers to compare and validate new remote sensing techniques against traditional methods.

The facility allows vital testing, calibration and verification of technologies in order to prove reliability, data availability and performance in a remote offshore environment. It can also be used to evaluate environmental conditions, observe marine conditions and collect wildlife data for research and development purposes.



Services

- Hosting floating Lidar trials
- Data licensing for wind and ocean conditions as well as environmental and wildlife research
- Consenting and permitting
- Project support
- Collaborative R&D projects and SME product development support

Additional services

- Hosting instrumentation and monitoring of new equipment
- Practice operation and maintenance procedures and training exercises
- Preparation of a verification report

“ORE Catapult’s facilities are a significant enabler to accessing the UK’s vast offshore resources.”

The Crown Estate



Levenmouth demonstration turbine

7MW open access offshore wind demonstration turbine.

ORE Catapult's 7MW offshore wind demonstration turbine, located at Levenmouth in Fife, is the world's most advanced open access offshore wind turbine dedicated to research and product validation.

The turbine offers a unique opportunity for researchers and product developers to trial and demonstrate new technologies on a fully operational offshore turbine. It enables the verification and validation of novel technologies by proving their reliability and performance in real-life operating conditions.

An identical power train system located in our 15MW nacelle test facility (see pages 6-7) enables simulation of actual operating load cases in a controlled test environment. This provides an accelerated learning and development period for new technology.

Beyond technology validation, the turbine also provides opportunities for training and demonstrating new operation and maintenance techniques. The turbine's proximity to the shore makes it an ideal environment to gain real-life experience on a state of the art offshore turbine.



Services

- Product validation of new concepts and technology
- Improve wind resource estimation and standardisation
- Holistic control system development, including control algorithm optimisation
- Prognostic condition monitoring system (CMS) development
- Measurement system development (DAQ, sensors)
- Measure and compare real-life data against a controlled test programme
- Structural mechanics
- Aeroelastic modelling
- Aerodynamic modelling
- Design and analysis tool evaluation

Additional services

- Evaluate environmental conditions, data and/or impact
- Conduct training
- Practice operation & maintenance (O&M) procedures
- Demonstrate remote inspection methods and technologies

“Access to the Levenmouth Demonstration Turbine will make it possible to position the UK academic research community right at the heart of European wind research, funding opportunities and technology development.”

EPSRC SUPERGEN Wind Hub



Innovation and research

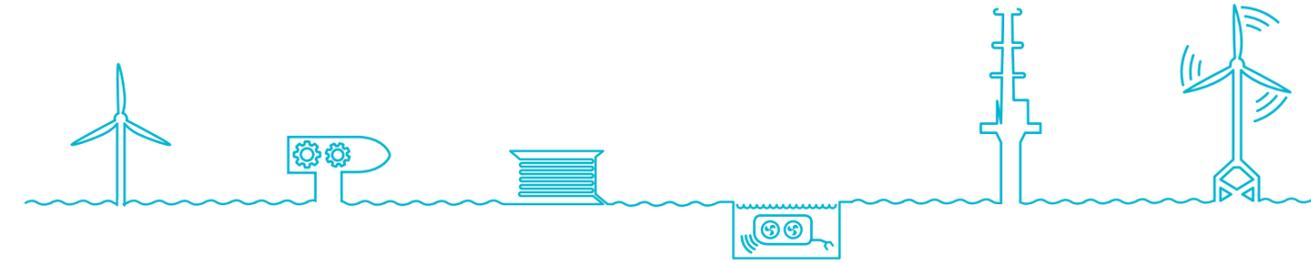
Driving forward offshore renewable energy through collaborative research programmes.

In conjunction with our testing and demonstration facilities, ORE Catapult regularly participates in large-scale collaborative R&D and innovative commercial and public funded projects, amassing vast technical knowledge and know-how to improve reliability and reduce the costs of offshore renewable energy. Our multi-disciplined team of highly qualified researchers and engineers, coupled with our full-scale testing facilities, have developed specialist knowledge and expertise in the areas of blades, power trains and electrical infrastructures.

ORE Catapult undertakes applied research projects from Technology Readiness Level 3 upwards - ranging from proof-of-concept and system tests, through to

demonstration and commercialisation. We have a strong track record, securing more than £70m of European and national research and development projects, and collaborate closely with a global network of universities, industry and governments to secure breakthroughs in the design, deployment and commercialisation of renewable energy technologies. We play a key role in international energy activity working closely with organisations such as IEA Wind, the European Energy Research Alliance (EERA), EUREC and TPOcean, advising on their EU and international energy strategy related to offshore renewable energy R&D.

We also sit on industry steering groups and advisory boards, such as SuperGen



Wind and SuperGen Marine as well as International Standards Committees such as the IEC and BSI. To help us engage with academia and industry, we have established specialist advisory groups. Our Research Advisory Group provides clear, consistent and representative academic and specialist research advice, and works in partnership with our Industry Advisory Group who help define, refine and adapt R&D objectives and facilitate access to expertise and capability within the UK and beyond.

Research priorities

- Power trains
- Blades
- Electrical infrastructure
- Condition monitoring and sensors
- Floating structures

Capabilities

- Specialised research
- Developing and delivering collaborative research projects
- Convening consortia - academic and industry partners to bid for public funding
- Establishing Joint Industry Programmes
- Project and programme management
- Technical due diligence
- Specialist consultancy
- Public funding expertise and guidance
- R&D proposal preparation
- Knowledge exchange - offering secondments into and out of universities, and encouraging closer engagement between our industry and academic stakeholders



**Independent,
open access facilities**
for offshore wind, wave
and tidal energy

CATAPULT
Offshore Renewable Energy





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Inovo

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