

# Supergen Wind Energy

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- EPSRC funded
  - Phase 1 ~ £2.5M 2006-2010
  - Phase 2 ~ £4.8M 2010-2014
  - Phase 3 ~ £3M + £3M 2014-2019
- UK wide consortium

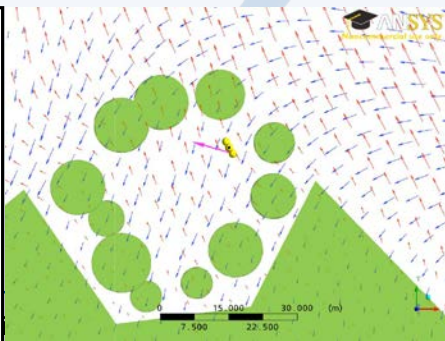
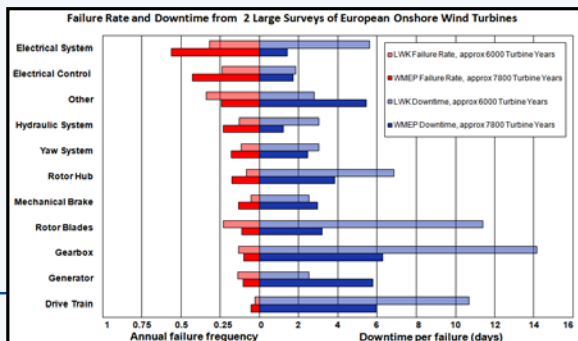


## ■ Mission statement

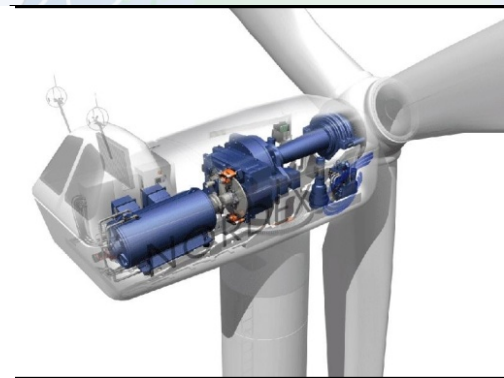
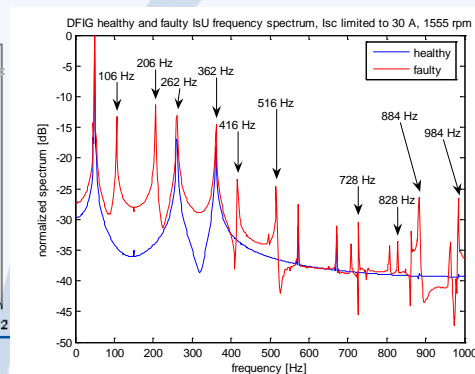
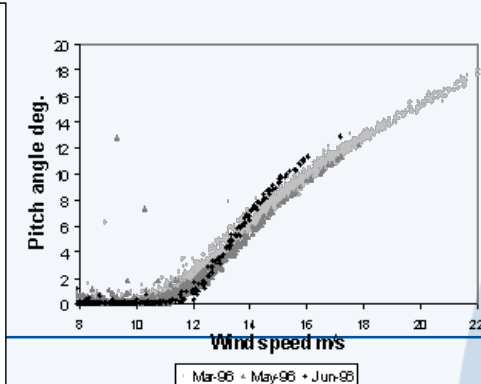
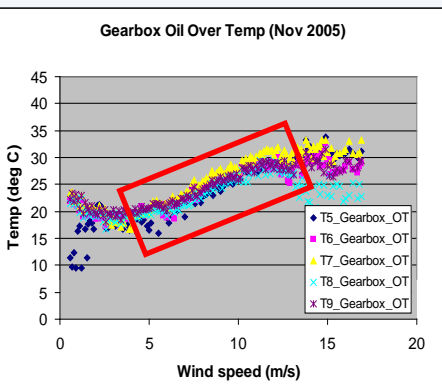
- “To undertake research to improve the cost effective reliability & availability of existing and future large scale wind turbine systems in the UK.”

## ■ Context: off-shore development using large-scale wind turbine

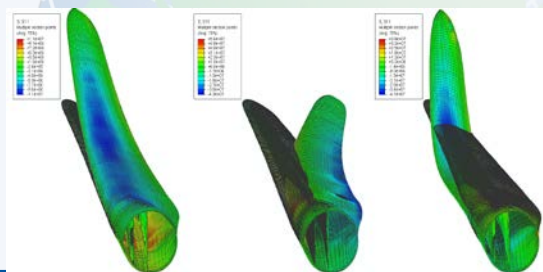
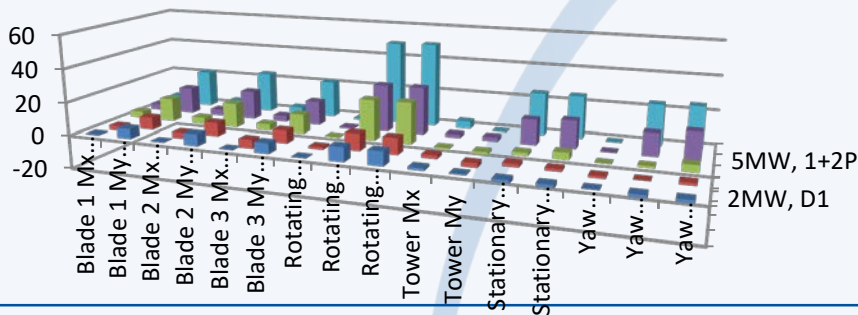
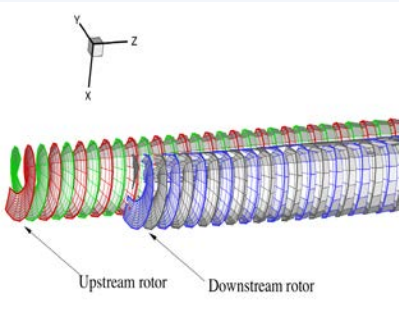
- Turbine sub-system failure rate analysis
- Wind tunnel measurements of multiple turbine wakes
- modelling of forest canopies



- DFIG analytic model modelling healthy and faulty states
- DFIG test rig built and operational
- Detection of faults on the test rig using electrical signals
- Algorithms for tracking fault frequencies in variable speed turbines

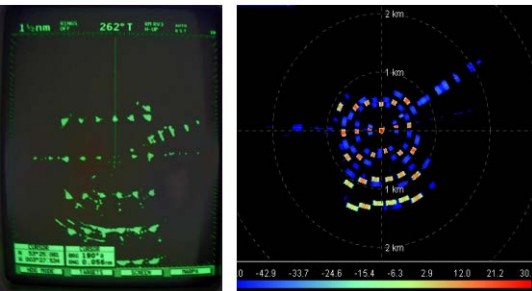


- Development of a two wake interaction model
- New composite materials to improve blade strength and durability
- Fully parametrised blade model
- Active reduction of tower and rotor loads.

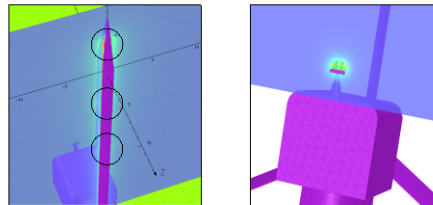


- Prediction and reduction of scour around monopiles
- Computationally efficient models of turbine and array for combined lightning protection and radar
- New materials to improve for combined lightning protection and radar

### Recent Modelling Results

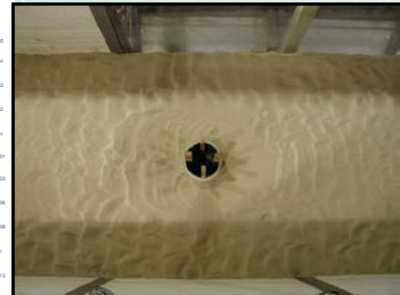
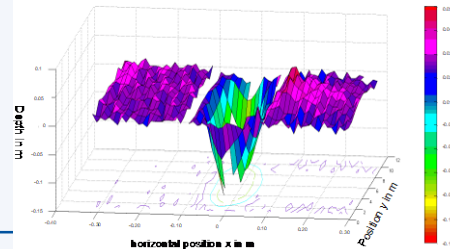


### FEA Modelling - 2



Field Enhancement at Blades and Windvane

### Mobile Bed







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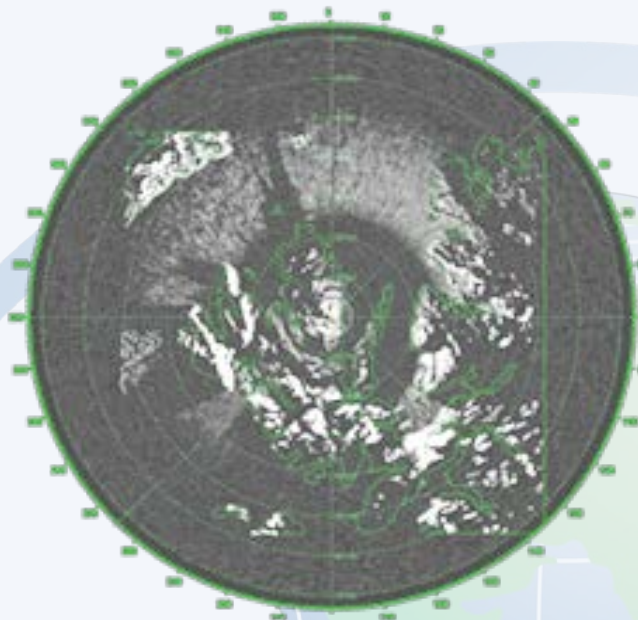
➤ “To undertake research to achieve an integrated, cost-effective , reliable & available Offshore Wind Power Station.”

## ■ Context: Large scale development of off-shore wind farms



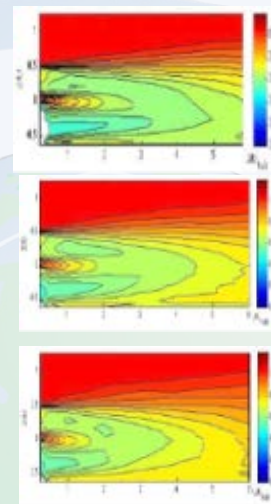
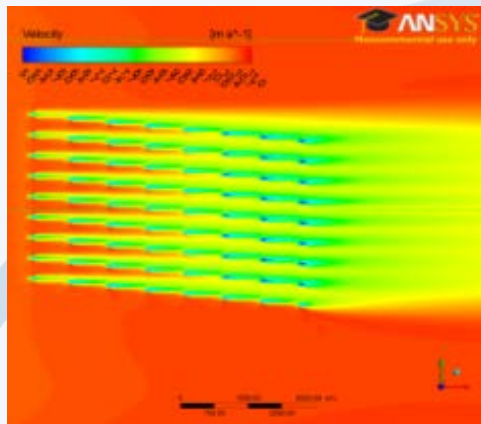
- Offshore wind resource
- Wakes and aerodynamics
- Radar and the environment
- Optimisation of farm performance
- Multiple wake impacts on machines

### Radar scattering



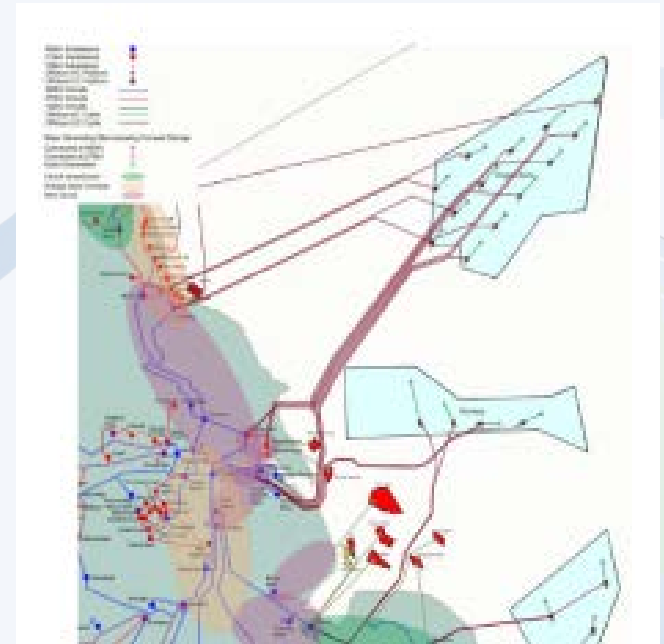
- Drive train dynamics
- Rotor wind field interaction
- Turbine blade and tower materials
- Fault detection
- Subsea turbine foundations

### Wake losses – energy yield



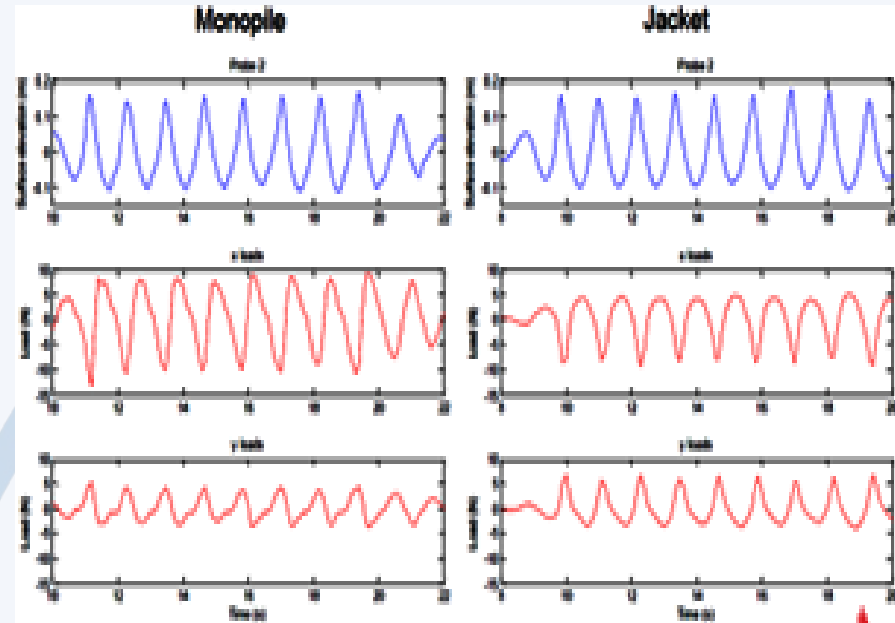
- System performance evaluation – Reliability/Connection
- Offshore control schemes – Connection
- Connection to Shore – Connection
- Integration of storage – Cost/Connection

## Connection



- Offshore connection
- Economics & performance
- Asset management
- Dynamic loading & structures

### Loading and materials



- Organisation of Work Programme
  - Theme W: *Base-lining Turbine Performance*
  - Theme X: *Condition Monitoring*
  - Theme Y: *Loads & Materials*
  - Theme Z: *Environmental Issues*



## ■ Mission statement

➤ “To achieve an integrated, cost-effective, reliable & available offshore Wind Power Station”

# Phase 3: Wind Hub

- Core research programme £1.2M
- Flexible funding £1.2M
- Networking £0.6M



# Phase 3: Wind Hub

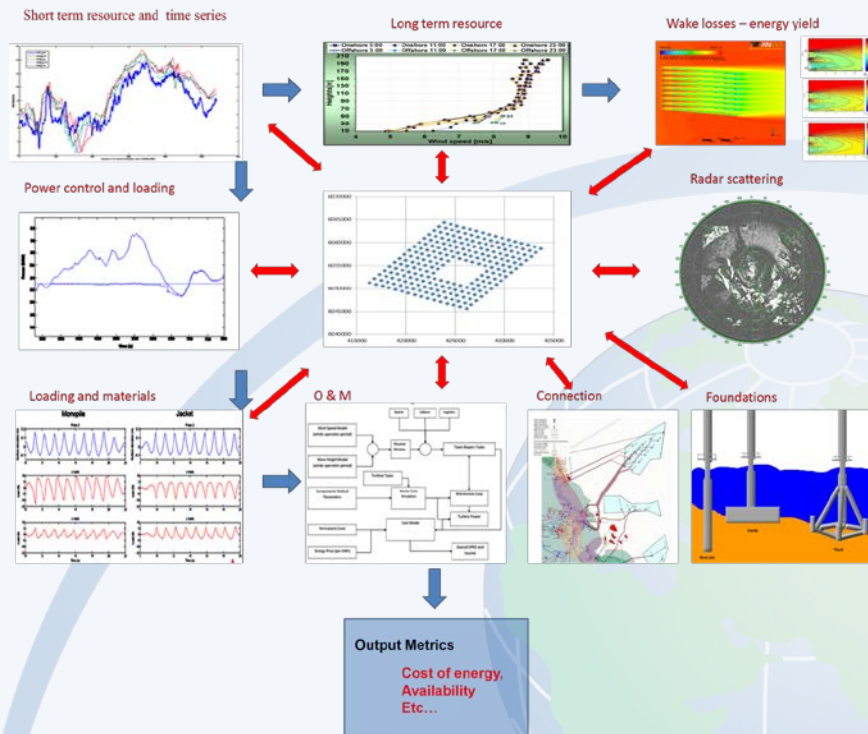
## Our members

- Universities of Strathclyde, Durham, Loughborough, Cranfield, Manchester, Oxford, Surrey, Bristol, Dundee, Imperial College London, Exeter, Edinburgh, UCL, Glasgow, alongside STFC, DNV-GL, OREC.



## Our research themes

- Planning and Consenting
- Design, Manufacturing and Installation
- Operation, Maintenance and Decommissioning



# Phase 3: Wind Hub

## Our Grand Challenges

- **MAXFARM (MAXimizing wind Farm Aerodynamic Resource via advanced Modelling):**  
Led by Dr Phil Hancock, Surrey
- **Maximising the Carbon Impact of Wind Power:**  
Led by Professor Richard Green, ICL
- **Screw piles for wind energy foundation systems:**  
Led by Dr Mike Brown, Dundee
- **Servo-aeroelastic tailoring of wind turbines using new active-to-passive control systems:**  
Led by Professor Paul Weaver, Bristol



## Our Flexible Funding projects

- **Round 1 Call (Dec 2015 – wind energy):**  
£280,029 awarded: Cranfield, Oxford, Strathclyde)
- **Round 2 Call (Jun 2016 - relating to OREC Levenmouth test turbine)**  
£319,251 awarded: Durham, Manchester/Glasgow/UCL,  
Strathclyde/Edinburgh
- **Round 3 Call (April 2017 - health and safety)**  
£234,555 awarded: Strathclyde/Exeter, Cranfield
- **Round 4 Call (Aug 2017 - floating wind)**  
£199,788 awarded: Cranfield/ICL,Cranfield/Strathclyde
- **Special Projects Call (May 2018 – developing current activities)**  
£305,363 awarded to 11 individual special projects

