



part of the **Natural Power** group



# OPERATIONAL ANALYSIS & OPTIMISATION

**We provide industry leading analytical services and wind analysis tools, supplemented by strong operational experience, giving real-world insight into the true performance of wind farms and realistic solutions to any operational problems. We have a proven track record in ensuring the returns on your asset are maximised. The aim is to provide accurate, informed auditing and troubleshooting for your operational wind farms.**

Our services include:

- **PERFORMANCE MONITORING ANALYSIS & OPTIMISATION**
- **DOWNTIME ANALYSIS**
- **INVESTIGATIONS**
- **FORECASTING**
- **CONDITION INSPECTIONS & MONITORING**
- **H&S AUDITING**
- **ENGINEERING**
- **ECOLOGICAL & HYDROLOGICAL MONITORING**
- **YIELD & RISK ANALYSIS**



# ONCE A SITE HAS BEEN COMMISSIONED, THE WORK CONTINUES. WITH A PROVEN TRACK RECORD IN ENSURING THE RETURNS OF ASSETS ARE MAXIMISED, OUR EXPERTISE EXTENDS INTO THE OPERATIONAL LIFE CYCLE OF A WIND FARM.



## DOWNTIME ANALYSIS

Downtime analysis is an essential part of wind farm operational management yet every year wind farm owners overspend by not being fully informed on the actual performance of the site through an independent analysis report, instead relying on the OEM's own SCADA and service reports. In addition the wind farm company are often unable to explain monthly or annual site performance to lenders and investors in terms of available wind and energy capture.

Through analysis of operational logs and raw SCADA data we can draw independent conclusions on site performance against the available wind resource in any period, to help client's understand the performance of the site, the availability of the turbines / grid and classify where each period of downtime is attributed both at main component level and, in line with any availability warranty, to assist in warranty claim or performance reward negotiations. This service can be provided on its own or as part of our range of Asset Management services. However, it works particularly well where we are involved in the management of the site through our 24/7/365 control room, WindCentre, ensuring we obtain a fully independent operational, access and handover history for each wind turbine.

- Monthly / Annual downtime analysis
- Monthly / Annual power performance analysis
- Annual budget revision
- Monthly / Annual warranty availability calculation\*

\*For warranty claims this service can now be provided on a no win no fee basis subject to joint agreement



## PERFORMANCE ANALYSIS & OPTIMISATION

Some wind farms do not meet pre-construction expectations and require a detailed operational analysis to identify the reasons and rectify performance where possible.

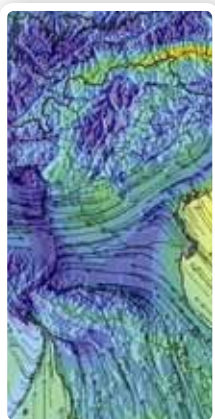
We can help clients understand the reasons for any difference between the budgeted generation of a wind farm and the actual performance. Our aim is to help our clients put plans in place to improve the energy capture as a result of our analysis. Our techniques allow anecdotal under-performance to be closely and accurately quantified, providing a clear focus on the turbines, systems and components which require attention and following through with engineering reports and cost-benefit analyses to identify any potential solution with the aim of delivering better financial returns from the wind farm.

- Downtime analysis
- Power performance analysis by site and turbine
- Directional power performance analysis by site and turbine
- Advanced wind flow modelling and measurement analysis to identify reduced turbine performance areas
- Budget revision in line with post construction analysis
- Investigation of grid and HV issues
- Improved Site Management strategies



## INVESTIGATIONS

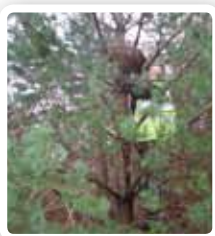
Natural Power is being increasingly requested to investigate post-construction issues at wind farms. These issues include civil engineering problems such as poor drainage, substation settlement, grid issues and wind turbine foundation cracking. We review the as-built documents and retrospectively check the construction process and methods employed to identify failings in design, management and / or construction procedures. We will act as technical experts in wind farm legal proceedings to bring in our extensive experience of planning, designing, constructing and operating wind farms.



## FORECASTING

Natural Power have developed ForeSite™ - a forecasting service for power production, providing a site - specific power forecast for any project worldwide on a daily or hourly basis. Owners now have the ability to address trading / dispatch risks and to optimise downtime scheduling. The resolution of the meteorological model used (Meteoblu<sup>®</sup>) over regions of interest is typically better than that of the local meteorological service, and with a much longer prediction horizon, thereby providing a uniquely powerful forecast. This best-of-breed meteorological forecasting is merged with Natural Power's industry-leading practical wind farm consulting and management services, bringing knowledge from the ground up to improve the accuracy and relevance of forecasts for individual wind farm sites.

10 day forecasts can also be provided as part of our Asset Management Services to assist in work planning and maintenance scheduling to optimise production during higher wind speed periods.



## ECOLOGICAL & HYDROLOGICAL MONITORING

Our ecology team can provide operational ecological and hydrological monitoring, including routinely being part of the steering group or management committee for a range of sites. Onshore this can extend to bog restoration, heather management and comprehensive habitat, land, water and ornithological monitoring plans. Offshore this includes managing marine ecological monitoring plans, analysis reporting and assessment work for wind, wave and tidal projects.



## CONDITION INSPECTION & MONITORING

Natural Power offers valuable assistance to wind farm owners, insurers and lenders by providing high-quality wind turbine inspection and auditing services. Throughout the life-cycle of a wind farm project our mechanical, electrical and control system engineers inspect and report on the physical condition of wind farm assets, and in particular highlight any safety-related issues that need immediate attention. Our engineers are knowledgeable of the requirements for effective asset service and maintenance and expertly report on the performance of wind farm service and maintenance providers.

We offer periodic inspections of both onshore and offshore turbines at various stages in the project life-cycle. Routinely we offer inspection services during:

- Manufacture
- Erection
- Post commissioning
- End of warranty
- Failure investigation

Natural Power provides a full visual inspection of the following components, complete with functionality checks where appropriate:

- Cabling
- Tower ladder access and safety systems
- Tower paintwork
- Blade pitch systems and control
- Internal drive-train gearbox endoscopic inspections
- Vibration analysis of the gearbox
- Alignment checks of the high-speed shaft drive train
- Gearbox oil and pitch hydraulic oil sampling and analysis
- Detailed external blade inspection using a rope access team
- Detailed external structure inspections above ground height
- Visual inspection of the internal main bearing components including grease analysis
- Thermographic and visual inspection of HV switchgear, electrical cabinets, transformers and cabling
- Other more specialised services as requested by the wind farm operator

Of paramount importance to all site owners is the safety of personnel involved with running the wind farm and the safety of the public. There is an increasing requirement to check the structural integrity of the turbine as well as auditing the work practices of maintenance personnel. Natural Power inspects the fall-arrest and climbing equipment within the turbines as well as checking the condition of lifting gear and pressure vessel equipment. In the UK we check safety-critical systems against LOLER, PUWER, electrical safety and other regulations as applicable.

In addition to turbines we also audit the safety of electrical systems within on-site substations and external turbine transformers. Natural Power has a number of in-house Senior Authorised Persons who are fully qualified to work on high-voltage switchgear and transformers.

## YIELD & RISK ANALYSIS

Natural Power offer the following wind resource and energy yield services on operating projects:

- Wind climate and energy yield studies; post-construction energy yield uncertainty analysis and risk review; review of layout and turbine suitability; use of operational wind farm data to address post-construction yield analysis; use of operational and remote sensing data to secure finance for proposed wind farm repowering
- ZephIR wind lidar measurements (easily-deployed bankable measurements up to 200m without a mast)
- VENTOS CFD: Proven, advanced wind flow analysis for complex and forested sites, used to identify site classification issues and to reduce wind resource risk and uncertainty





## H&S AUDITING

We provide qualified and experienced personnel with detailed knowledge of land and marine legislation and current best practice guidelines. We specialise in Health & Safety Executive (HSE) management of onshore and offshore projects and are well placed in terms of expertise to manage construction, operations and routine maintenance.

Our HSE professionals have extensive experience working onshore and offshore and can support clients with:

- Preparation of safety management systems
- Review and gap analysis of existing safety management systems
- Preparation or review of method statements
- Compilation and audit of existing documentation to ensure regulatory compliance, including Construction Design and Management (CDM) compliance
- Training and system deployment
- Site induction programmes
- Internal Health and Safety audits prior to audit by certifying bodies
- Contractor competency assessments
- Facilitation and management of HAZID and Risk Assessment processes

Natural Power consider it vital that audits directly reflect the site-specific constraints and project demands. We are fully conversant with the wide range of Maritime Legislation and Management Systems relevant to offshore construction projects. Our in-house Master Mariners and HSEQ specialists have experience in vessel and equipment auditing and have all relevant formal audit training from the marine industry. We can perform audits on the following standards and systems:

- International Safety Management Code (ISM)
- International Ship and Port Security Code (ISPS)
- ISO 9001 (Quality), OHSAS 18001 (Health and Safety) and ISO 14001 (Environmental)
- International Marine Contractors Association – Common Marine Inspection Document (CMID)
- General Internal Business Management System audits
- A large proportion of our auditors are also certified CDM Co-ordinators able to conduct audits in line with CDM regulations.



Offshore these services are provided in partnership with SeaRoc, part of the Natural Power group

## ENGINEERING

Our engineering team offer a full range of engineering project management and design services to support a project from conceptual design through construction to the operation and maintenance phase. We have extensive onshore and offshore project experience and offer a wide range of competencies in civil, geotechnical, structural mechanical and electrical engineering.

Offshore, we draw on experience from the oil and gas, marine cabling, marine civil, offshore geological investigation and marine and naval architecture industries. This, coupled with our onshore construction and operations experience, provides a broad knowledge base to assist our clients with the engineering challenges presented during wind farm development. Our services include:

- Turbine and associate equipment selection
- Owner's Engineer
- Installation Engineering
- Construction Monitoring
- Interface Management and Construction Management Support
- Due Diligence



## PROJECT LIST

PROJECT	LOCATION	MW
Arnish Moor	Scotland	3.9MW
Caton Moor	England	16MW
Coldham	England	16MW
Craig Wind Farm	Scotland	10MW
Craigengelt	Scotland	20MW
Crystal Rig	Scotland	62.5MW

PROJECT	LOCATION	MW
Crystal Rig II	Scotland	138MW
Haverigg	England	2.4MW
Hill of Fiddes	Scotland	6.9MW
Ness Point	England	2.75MW
Pauls Hill	Scotland	64.4MW
Rothes	Scotland	64.4MW

PROJECT	LOCATION	MW
Sigurd	Scotland	1.3MW
Tullo	Scotland	17.5MW
West Durham	England	24MW
Wharrels Hill	England	10.4MW

## NATURAL POWER & REV1 RENEWABLES PROVIDE JOINT ASSET MANAGEMENT SERVICES IN NORTH AMERICA



Natural Power and Rev1 Renewables have fostered a combined management and services client portfolio of 1340MW of wind and solar energy projects. Natural Power's services include 24/7/365 remote monitoring via an operational control room – WindCentre™ – power-production forecasting, SCADA Analysis and HSE Management. Rev1 Renewables is a division of Rev1 Power Services established in 2008 providing skilled turbine technicians and support functions for turbine inspections, maintenance cycle completion and post-warranty operations and maintenance. Rev1's clients include General Electric, Edison Mission Energy, NextEra Energy Resources and Horizon Wind.

This joint services agreement combines Natural Power's in-depth expertise in providing management services on a large fleet of wind projects with Rev1's field service crews and local expertise allowing for a fully independent asset management offering for small and large wind farm owners/operators alike. Furthermore, Natural Power's business model, which combines technical wind resource assessment as well as hands-on operational experience, provides a unique perspective in analyzing operationally 'troubled' wind farms – a strategy already demonstrated across Europe.

### ISO CERTIFICATION

Natural Power have established rigorous procedures and work instructions for all aspects of our business. All staff currently work to a list of core procedures for quality & environmental business management. Full details of our integrated QE management system are available on request. The following scopes for ISO 9001:2008 have been achieved, applicable to all our UK operations:

#### Technical Services UK

Resource management, analysis, modelling and design for the pre-construction phases of onshore and offshore renewable energy projects, including the application of tools and the methods of assessing complex flow environments for wind, wave and tidal environments.

#### Development Consultancy Services

Project management, consent management, due diligence and consultancy services including initial site feasibility studies, land agreements, management of the EIA process and planning applications, stakeholder consultations, permitting and discharge of planning conditions of renewable energy projects (onshore & offshore wind, wave, tidal, biomass, PV, hydro and associated infrastructure).

#### Construction & Ecology Management Group

Project management, due diligence and consultancy services (to include pre and post construction phases) for the construction of wind farms and biomass energy projects with associated site investigation services and onshore/offshore ecological services.

#### Asset Management

Wind farm operational site management.

