

Renewable energy consultants

GL Garrad Hassan



Wind Farm Extensions – Minimising Uncertainty in Long-Term Forecasts

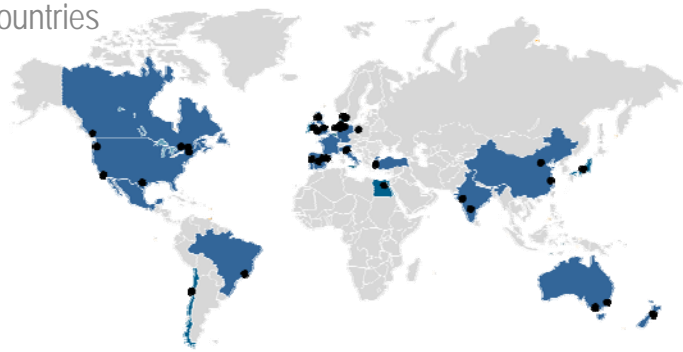
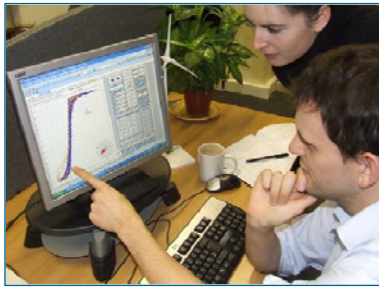


www.gl-garradhassan.com



GL Garrad Hassan

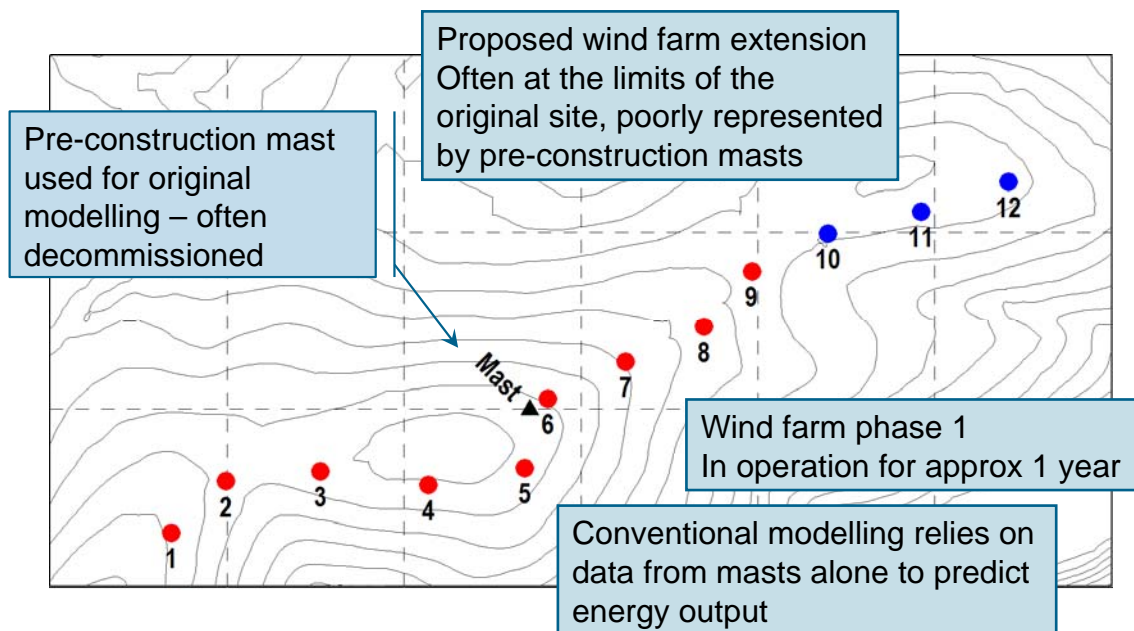
- World leading renewable energy consultancy
- 750 staff, 41 locations, 22 countries



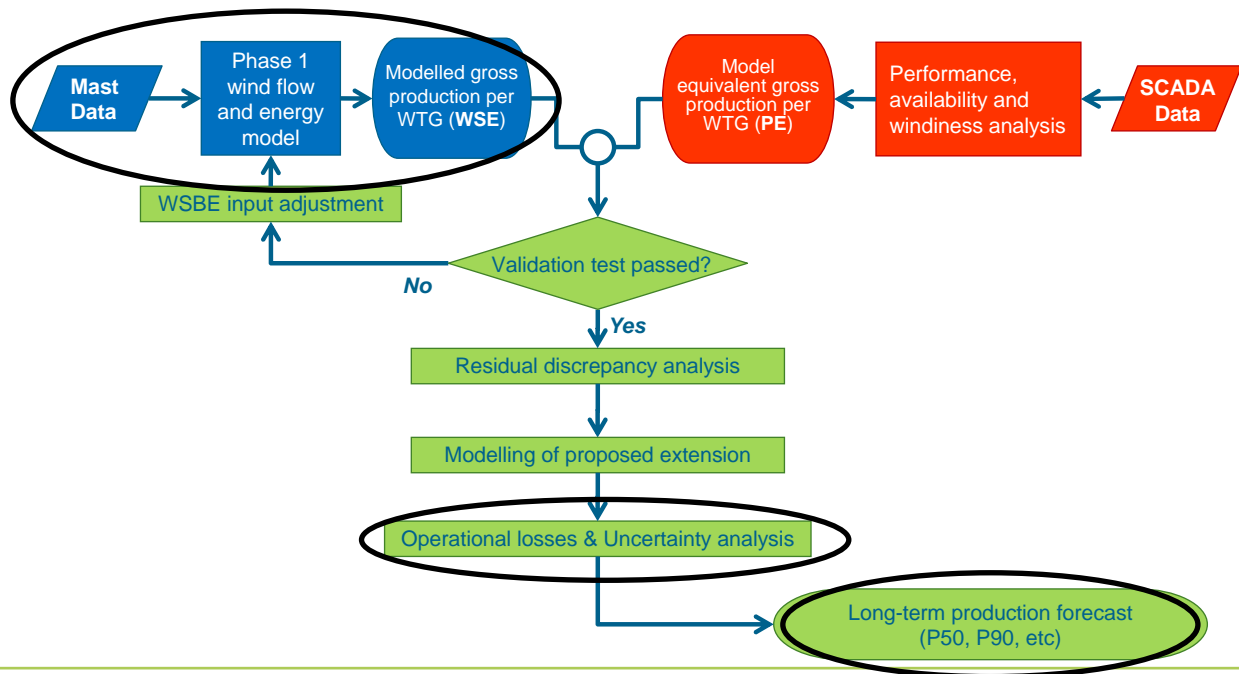
Asset Management and Optimisation Services (AMOS)

- 30 engineers worldwide
- Over 25GW of operating plant assessed worldwide
- 140MW of extensions analysed at 18 sites in the UK, Ireland (500MW+ globally)

What Is A Wind Farm Extension?

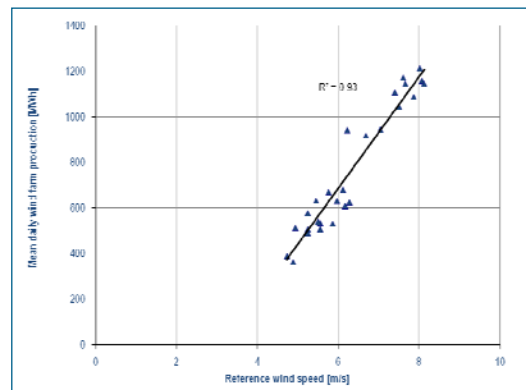
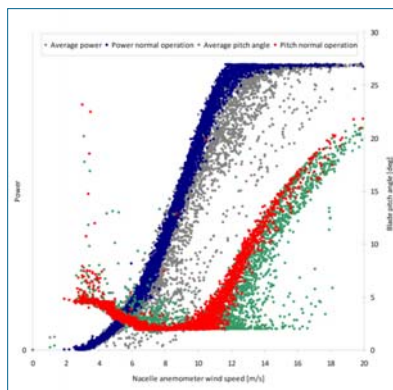


Summary of GLGH methodology



SCADA Data Analysis (1)

- Analysis of SCADA data gives insight into the performance of the existing project
- Established techniques used to account for intermittent performance issues, availability and windiness trends
- Output is an estimate of overall gross wind farm production – 100% availability, normal power performance and no operational losses



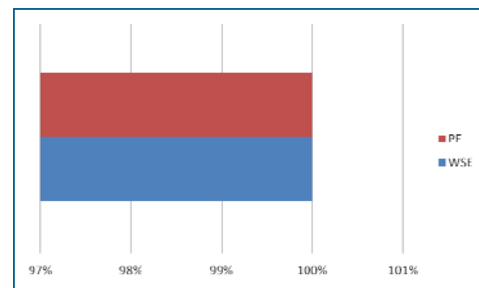
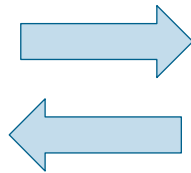
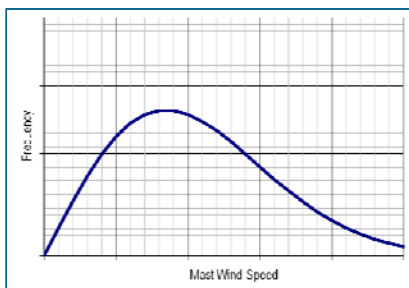
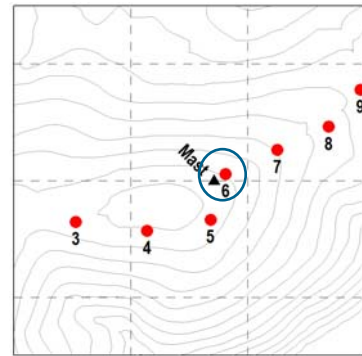
SCADA Data Analysis (2)

The production based estimate (PE) is derived using a combination of:

1. Overall wind farm production based estimate
2. Relative pattern of production across the site;
 - Availability and Performance corrections made
 - Data coverage needs consideration
 - Synthesis between turbines may be required for a valid pattern
 - Response of turbines to complex flow conditions inherent in this pattern

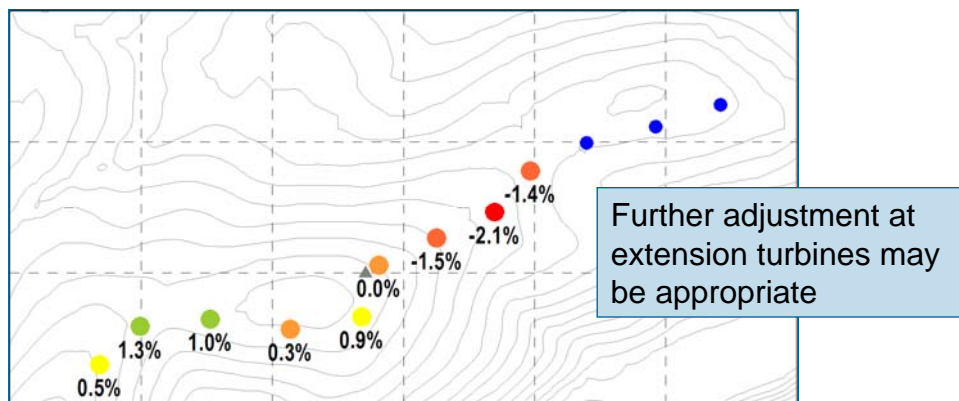
Model Validation Feedback Loop

- Comparisons undertaken at a number of 'validation' turbines
- Locations chosen where modelling is most reliable
- WSE input adjusted until agreement with PE is reached



Model Validation – Residual Discrepancy Analysis

After validation test is complete, residual discrepancies at other turbine locations will remain



This methodology provides more insight into the performance of WSE models:

- Turbine response to complex flow conditions (i.e. turbulence, upflow, wind shear)
- Uncertainties in the topographic, forestry and wake modelling

Operational Losses and Uncertainty Analysis

Conventional operational losses applied to obtain a P50 central estimate of long-term energy production

Uncertainty considerations:

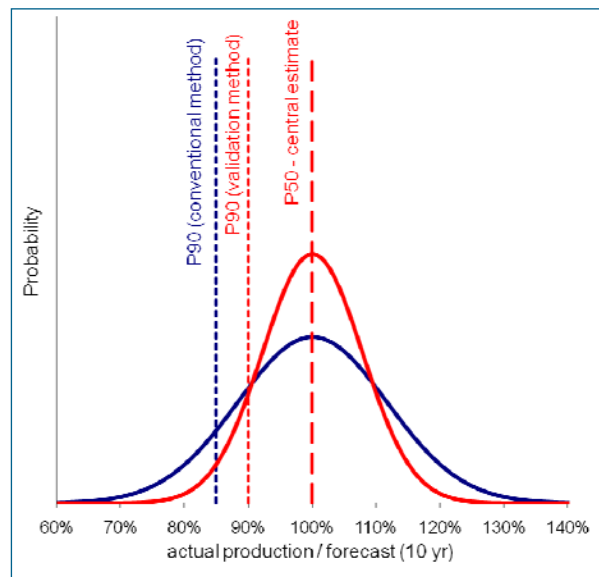
- Historical / future variability remain dominant
- Modelling uncertainties can be significantly reduced
- Additional uncertainties due to SCADA analysis are usually small

Typical UK P90 / P50 ratio (10yr)

Conventional models: 85

%

Validation method: 90 %



Methodology Limitations

Uncertainties are minimised when:

- Detailed SCADA data analysis is performed
- Extension and Phase 1 turbines have the same configuration
- Phase 1 turbines representative of the extension
- Pattern of residual discrepancies show clear trends

Some important caveats:

- Benefit is reduced when extension is large and / or distant from Phase 1 – additional wind speed measurements may be required

Concluding Remarks

- SCADA data are a powerful tool when considering a wind farm extension
- Model validation yields significant reductions in extension EPA uncertainties
- Valuable insights into
 1. Site specific model performance
 2. Performance and availability of existing plant
- Method presented is bankable and applicable to
 1. Onshore and Offshore projects
 2. Project extensions
 3. Repowering
 4. Reconciliation analyses (with care!)

GL Garrad Hassan



Thank you

andrew.strachan@gl-garradhassan.com
www.gl-garradhassan.com

Come and visit us at Stand 186



www.gl-garradhassan.com

