

# P90 FULL LIFE ANALYSIS

## INTRODUCTION

The **P90 Full Life Analysis** to “see what is invisible”, identifies how the site specific conditions are affecting the wind assets and obtains a Life Expectancy for the structural and rotational components of each wind turbine, modeling in detail the mechanical fatigue degradation of the components according to the turbine morphology, site conditions, detail operation conditions and type of materials.

## CONCEPT

The P90 Full Life Analysis is the first basis to support all the activities related to a full asset redevelopment, such as Life Extension, Maintenance Adaptation and Performance Improvement, since it identifies the hidden potential given by the site specific conditions to reduce risks and costs in O&M, extend long term operation period of the wind farm and maximize AEP – Annual Energy Production, adopting in each case the optimal configuration of the technical tools which nabla wind hub can deploy.

The client directly obtains the following **benefits**:

- **Immediately upgrades the Long-Term Value of the Asset**, re-structuring the Business Plan from 20 years to 25, 30, 35 or even 40 years, upgrading the IRR – Internal Rate of Return and reducing the LCOE – Levelized Cost of Energy.
- **Identifies the scope of actions which need to be done for achieving the Life Extension target**, in terms of:
  - **Detect the time-to-failure of the Components**: obtaining a diagnosis of the Long-Term Value of the Asset, Long-Term Risk Management Plan and Potential for Life Extension
  - Set the Plan and optimize required Investments for Turbines Life Extension scenario, based on the identification of **selective minimum retrofits** for a Long-Term Operation Protocol for each wind farm
- **Reduces Costs in Maintenance**, by means of:
  - **Tailoring Maintenance Plan** by means of identification of High-Risk vs Low Risk components and adaptation of the standard Maintenance Plan adapting inspection and maintenance procedures to the specific needs and conditions of the particular wind farm. “Health Care” concept
  - **Anticipate, control and plan the maintenance actions**, allowing a cost and downtime reduction and anticipate and prevent technical obsolescence or problems in the supply chain for spare parts, due to the adequate planning of the selective retrofits to carry out

# METHODOLOGY

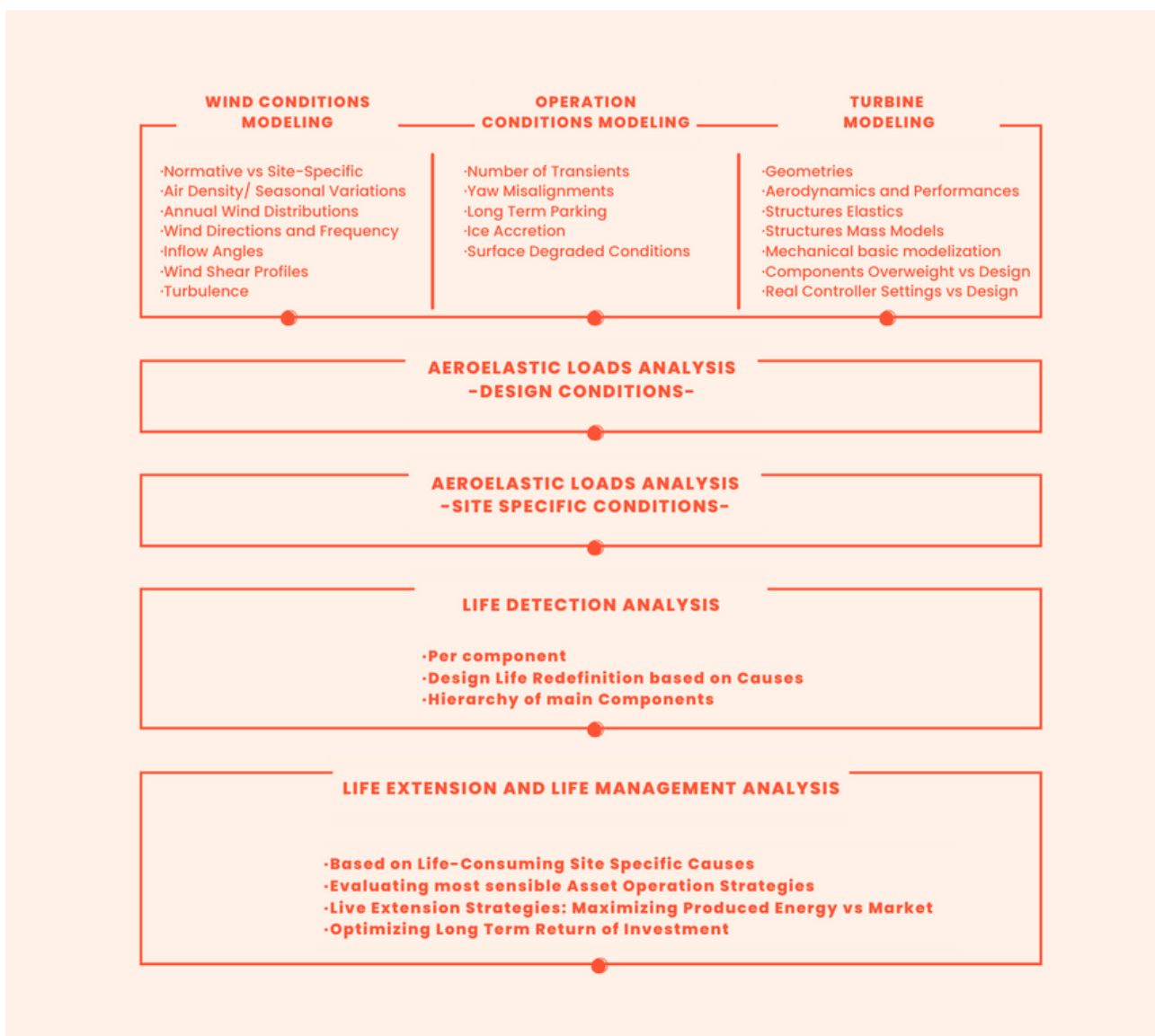
It is based on a **simple principle**:

Turbines are designed against standard and regulated wind conditions which usually are conservative with real site wind records.

This implies that, in spite of wind turbines to be designed for a design life of 20 years, in reality their design life can vary from site to site and usually can be extended.

The effect of these real conditions on the turbines are merged and evaluated together in a simultaneous and coupled analysis by means of a very detailed **Aeroelastic Loads Calculation** for which the turbines dynamic performance is simulated according the specific conditions and compared with the design conditions.

The process and its details are protected by a WO PCT "International Patent" applied by nabla wind hub **PCT/ES2013/070537**, and consist of:



The P90 Analysis by nabla wind hub:

- 1 provides the highest standard in the market for Life Extension Potential Analysis, since achieves a maximum uncertainty of 10% (thus its nomenclature P90), aligned with maximum 10% difference allowable by Type Certification between models and measurements,
- 2 follows and expands the new IEC 61400-28 Life Extension Normative, in which nabla wind hub is in charge of 2 of the 5 Normative working groups,
- 3 and is the basis for achieving a Certification of the Life Extension Plan of the wind farm, if required by the client or any stakeholder.

## OUTCOMES

The P90 analysis delivers a technical report per calculation cell with the **Life Results (Time-to-Failure) of the turbine components per turbine** and identification of the **dominant causes and regimes which consume life**. In addition to the LTE report, an **Long Term Maintenance Recommendations** report providing recommendations to achieve the identified LTE is shared.

Every analysis is detailed: turbines particular characteristics, specific wind conditions, operation conditions, load cases architecture, simulations, results, and comparatives. Uncertainties assessment results are also provided.

## REFERENCES

**nabla wind hub** is an independent technology platform that delivers asset redevelopment projects for the wind industry worldwide. End-to-end & one-stop-shop partner for SPVs and Portfolios revaluation, through Life Extension, Performance Improvement and Maintenance Optimisation; based on state of the art technologies, such as top-accuracy aeroelastic models, in-house rerotoring components, and advanced monitoring solutions.



600 wind farms assessed



1200 sensors installed



2000 blades installed



+250 Wind Turbines monitored

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