Wind turbine life extension – standards & guidelines

GL 2009 - GLIV-1 12 Guideline for the Continued Operation of Wind Turbines

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GL 2009 - GLIV-1 12 Guideline for the Continued Operation of Wind Turbines

12.1 Introduction

Fundamentally, there are two different approaches to providing the necessary verification: a distinction can be made between analytical and practical methods.

The analytical method is an assessment conducted by means of new calculations for the wind turbine, taking into account the site-specific installation and its local conditions.

The practical method is an assessment through inspection of the wind turbine, in a similar manner to the general roadworthy inspection performed on motor vehicles.

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12.3 Requirements for the experts

All inspections of the wind turbine as well as all evaluations of loads and/or components of the turbine to be performed within the scope of the assessment with regard to continued operation in accordance with this Guideline shall be carried out by qualified, independent experts for wind turbines. These experts shall be recognized by Germanischer Lloyd (GL) and shall have the technical competence for proper assessment of the entire wind turbine. Evidence of the corresponding education and training as well as an ongoing exchange of experience shall be provided. Accreditation as per DIN EN ISO/IEC 17020 or DIN EN 45011 (or equivalent) is required.

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12.6.1 Assessment through renewed calculation (analytical method)

12.6.1.1 General

As the basis for assessment through renewed calculation, it is as a rule necessary to use the current version of the guideline which served as the basis for the issuing of the building permit or for the certification. The current state of the art and the country-specific regulations shall be considered in addition.

12.6.1.2 Procedure for analysis

The structural integrity and the remaining service life of the wind turbine as a result of extreme loads and fatigue loads shall be verified by the manufacturer or operator, and assessed by GL. The result of the assessment is documented in an expert report.

12.6.1.3 Periodic Monitoring

Subsequent to the analytical assessment by the expert, Periodic Monitoring shall be performed.

12.6.2 Assessment through inspection (practical method)

12.6.2.1 General

The objective of the inspection is to assess the wind turbine with regard to its suitability for continued operation; the inspection shall include the machinery, rotor blades, safety system, tower, foundation and thus the condition of the entire installation. The result of the inspection is documented in a record concerning the inspection of the wind turbine for continued operation.

Table 12.6.1 Assessment scope of the inspection

Assembly
Rotor blade
Nacelle and force- and moment-transmitting components
Hydraulic system, pneumatic system
Tower and foundation
Safety system, sensors and braking systems
Control system and electrics including transformer station and switchgear

DNVGL-ST-0262 – Standard: Lifetime extension of wind turbines

1.1 General

1.1.1

This DNV GL Standard provides principles, technical requirements and guidance for extending the lifetime of wind turbines onshore and offshore.

2.1.1.3 The evaluation of a turbine with regard to an extension of service life shall always be based on a combination of an analytical part and a practical part.

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Table 2-1 Assessment scope

Component/System	*Parts*
Rotor Blade	Blade
Machinery components	Hub Main shaft Torque arm Main bearing housing Main frame Rear frame Spinner and nacelle cover Pitch system Main shaft bearing Gearbox Bolt connections Yaw system
Tower	Tower segments Tower connections Door opening
Foundation	Anchor bolt connection Embedded steel section Slab foundation Pile foundation Jacket structure (offshore) Monopile structure (offshore) Grouted connection
Control and protection system	Sensors Braking systems Control software
Electrical Equipment	Generator Lightning protection

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APPENDIX A METHODS FOR LIFETIME EXTENSION

Table A-1 Methods for lifetime extension assessment

Method	*Scope*	*Main outcome*	
Lifetime extension inspection (LEI)	— visual inspection of all load-transferring and safety-relevant components — review of maintenance reports and inspection reports for specific turbine — consideration of SCADA data — consideration of wind turbine type related field experience — simple tests	evaluation, if turbine is suitable for lifetime extension	
Simplified approach for lifetime extension	Analytical part: — load calculation, may be performed using generic turbine model — calculation of possible extension of lifetime based on environmental conditions as per original design vs. environmental conditions at the site — possibly accompanied by load measurements Practical part: — inspection based on general inspection plan — visual inspection of all load-transferring and safety-relevant components — review of maintenance reports and inspection reports for specific turbine — consideration of SCADA data — consideration of wind turbine type related field experience — performance of tests	— specification of possible lifetime extension — specification of required inspection scope and intervals based on inspection results and results analytical part — specification of restrictions/conditions (.e.g. component exchange, installation of CMS, etc.) if required	Proof of strength and stability
Detailed approach for lifetime extension	Analytical part: — load calculation based on specific turbine model — calculation of possible extension of lifetime based on environmental conditions as per original design vs. site specific environmental conditions and utilization rate of components — reserve calculations on load-transferring components — possibly accompanied by load measurements — possibly optimization of control system — consideration of turbine type related field experience — development of turbine-specific inspection plan Practical part: — inspection as per turbine-specific inspection plan that has been developed in the analytical part — visual inspection of all load-transferring and safety-relevant components — review of maintenance reports and inspection reports for specific turbine — consideration of SCADA data — consideration of wind turbine type related field experience — performance of tests	— specification of possible lifetime extension — specification of required inspection scope and intervals based on inspection results and results analytical part — specification of restrictions/conditions (.e.g. component exchange, installation of CMS, etc.) if required	Proof of strength and stability
Probabilistic approach for lifetime extension	Analytical part: — structural reliability analysis (stochastic approach) — calculations based on generic or specific turbine model — selection of reliability levels — identification of failure modes — possibly accompanied by load measurements — possibly optimization of control system — consideration of turbine type related field experience — development of turbine or site-specific inspection plan Practical part: — inspection as per turbine-specific inspection plan that has been developed in the analytical part — visual inspection of all load-transferring and safety-relevant components — review of maintenance reports and inspection reports for specific turbine — consideration of SCADA data — consideration of wind turbine type related field experience — performance of tests	— specification of possible lifetime extension respectively reliability level — specification of required inspection scope and intervals based on inspection results and results analytical part — specification of restrictions/conditions (.e.g. component exchange, installation of CMS, etc.) if required	Proof of strength and stability

DNVGL-ST-0262 – Standard: Lifetime extension of wind turbines

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DNVGL-SE-0263 – Service specification: Certification of lifetime extension

Table A-1 Methods for lifetime extension assessment

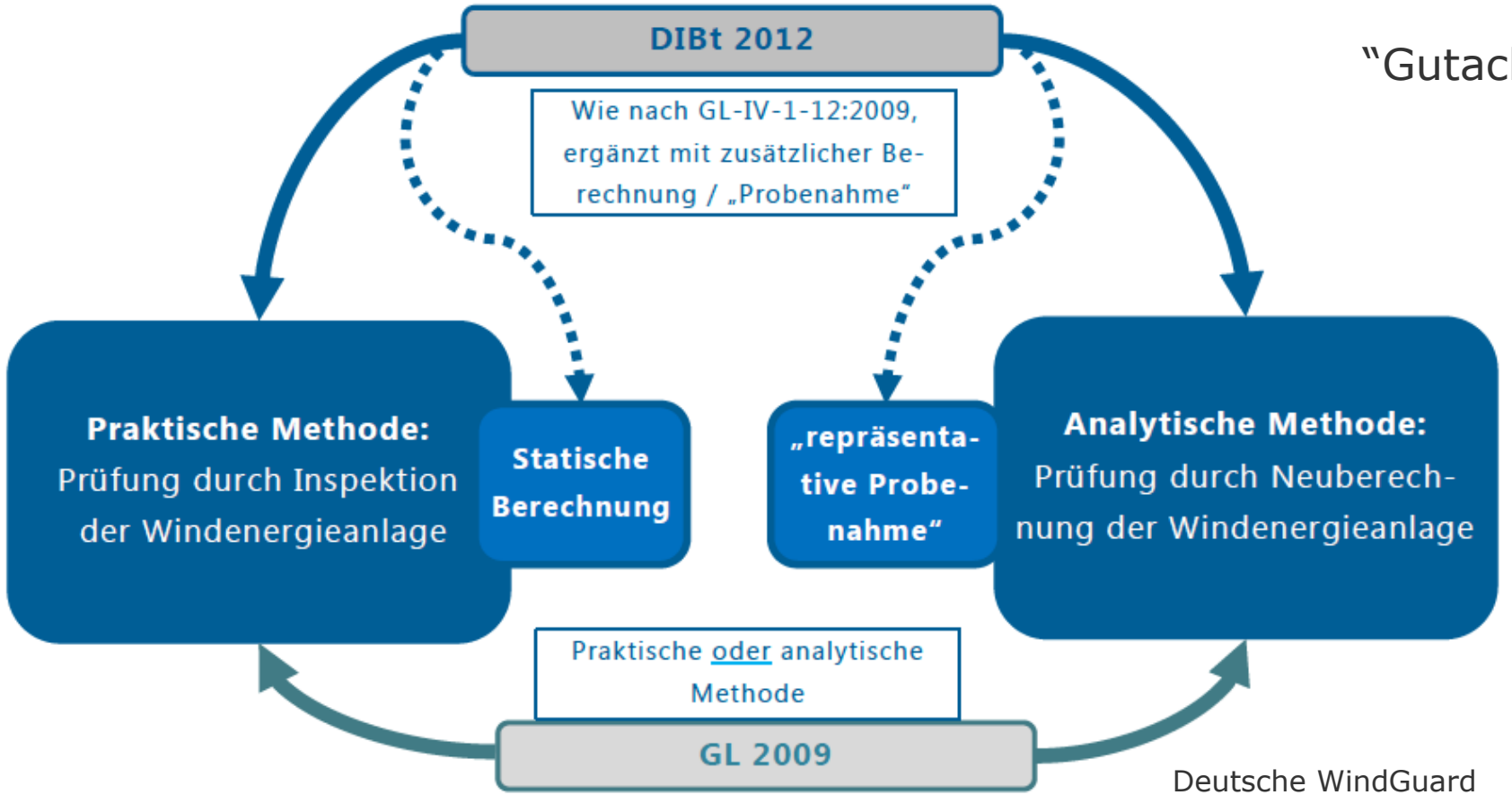
Method	*Service*	*Main deliverables*	*Result*
Lifetime extension inspection (LEI)	Lifetime extension inspection (LEI)	Report "Lifetime extension inspection"	Suitability for lifetime extension
Simplified approach for lifetime extension	Analytical part Lifetime extension inspection (LEI)	Statement of compliance "Analytical part lifetime extension, simplified approach" Certificate "Lifetime extension, simplified approach"	Proof of strength and stability
Detailed approach for lifetime extension	Analytical part *) Lifetime extension inspection (LEI)	Statement of compliance "Analytical part lifetime extension, detailed approach" Certificate "Lifetime extension, detailed approach"	
Probabilistic approach for lifetime extension	Analytical part *) Lifetime extension inspection (LEI)	Statement of compliance "Analytical part lifetime extension, probabilistic approach" Certificate "Lifetime extension, probabilistic approach"	

Wind turbine lifetime extension in Germany

DIBt - Deutsches Institut für Bautechnik

“Gutachten zum Weiterbetrieb”

“Gutachterliche Stellungnahme”



Deutsche WindGuard

Wind turbine lifetime extension in Denmark

Executive Order No.73

- Annual inspection of RNA and substructure
- 3-year blade inspections

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