

Principles for the "Recurring Periodic Inspection of Wind Turbine Generator Systems"

adopted by the BWE 2012 Technical Experts Forum

Table of Contents

1. General	3
2. Objective and Purpose of the Recurring Periodic Inspection	3
3. Official expert's brief	3
4. Evaluation Principles	4
5. Records required for inspections	4
6. Scope of inspection	5
6.1 Examination of plant documentation	5
6.2 Inspection of the wind turbine generator system	5
7. Inspection report	7
8. Measures	8
9. Inspection results and inspection document	8

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1. General

Wind turbine generator systems are monitored during their operation through a combination of preventive maintenance and recurring periodic inspections. The recurring periodic inspections are intended for the purpose of detecting potential damages and reducing these. The task of the recurring periodic inspections is the inspection of the motor in the wind turbine generator system, the safety equipment as well as the stability of the structure. It is also intended to assist with the evaluation of the current condition.

Recurring periodic inspections are performed at regular intervals by suitable official experts on the motor and rotor blades as well as the supporting structure (tower and accessible areas of the foundations). The required inspection intervals for this depend on the permit, the type approval and the official expert's reports on the wind turbine generator system.

The recurring periodic inspection must be arranged by the operator of the wind turbine generator system at the required intervals. The operator must ensure the necessary prerequisites are in place for the proper performance of the recurring period inspection; he must, in particular, ensure that the required records and documentation are available for examination.

2. Objective and Purpose of the Recurring Periodic Inspection

As a rule, the recurring period inspection is monitored and maintained in its entirety by specialist companies on a regular basis and at short intervals. The recurring period inspection is based on this concept of regular inspections.

The official expert obtains an overview of the condition of the wind turbine generator system as a result of his personally performed inspection and by examining the monitoring and maintenance documentation. The recurring period inspection service is intended for the inspection of the machine in the wind turbine generator system, the safety facilities and the stability of the wind turbine generator system.

The recurring period inspection thereby records the current technical condition with regard to the required testing scope and is helpful in evaluating the current condition of the wind turbine generator system. The operator receives an inspection report on this condition. This enables the operator to decide on the further operation of the wind power installation within the following inspection interval.

The recurring periodic inspection is documented in an inspection report.

3. Official expert's brief

The recurring periodic inspection, according to the principles mentioned here, must be performed by official experts, who:

- meet the "Requirements for official experts for wind turbine generator systems" of the Technical Experts Forum of the Federal WindEnergie Association (BWE) and
- are members in accordance with the "Rules of Procedure of the Technical official experts Forum of the BWE".

The licensed official experts can be found in the "**List of Members Recognised by the BWE official experts Forum for the Performance of Recurring Period Inspections on wind turbine generator systems**", published by the BWE. This is available from the BWE e.V. and the Experts Forum.

4. Evaluation Principles

Wind turbine generator systems must comply with and be operated in accordance with the respective state building codes, permits, requirements, as well as the resulting technical building regulations, regulations and technical guidelines. The standards and directives in effect for the location must be observed and applied.

The inspections follow the following directive:

- "Wind Turbine Generator System Directive" (Richtlinie für Windenergieanlagen" (Einwirkungen und Standsicherheitsnachweise für Turm und Gründung) of the German Institute for Building Technology (DIBt) 2012 version (currently in the draft stage) and the reference standards contained therein.

5. Records required for inspections

All the required records, which allow the official expert to perform the recurring periodic inspection, must be available for inspection from the operator.

As a rule, this includes:

- Permit, including stipulations and ancillary provisions
- Inspection reports of the construction documents for tower and foundation from the type approval
or individual license including any other valid documents on the machine and rotor blades
- Type approval / individual testing: Requirements or inspection comments
- Commissioning report
- Requirements in load and ground reports
- Technical approval by DIBt or ETAG approvals (e.g. tensioning processes, built-in units)
- Maintenance specifications with entries or reports on completed maintenance work
- Maintenance history - Documentation

- Operating manual
- Reports on all prior technical inspections
- Documentation on modifications or repairs on wind turbine generator system
- Other suitable records

6. Scope of inspection

6.1 Examination of plant documentation

The required records must be examined. The plant documentation shall be examined with regard to:

- Completeness
- Compliance with requirements
- Abnormalities in maintenance history of wind turbine generator system
- Maintenance in accordance with maintenance specification
- Proper performance of safety tests
- Non-approved or subsequently conducted deviations with safety relevance

6.2 Inspection of the wind turbine generator system

The machine inclusive of the electrical equipment in the operating and safety system as well as the rotor blades is to be examined with regard to abnormalities relevant to stability.

The examination refers to faults, which could completely or partially endanger the stability of the plant and to faults which could result from direct dangers which could be produced by the motor or rotor blades.

During the inspection, the supporting structure (tower and accessible areas of the foundations), machine and rotor and essential components shall be examined and inspected especially for abnormalities and unacceptable deviations from the required conditions (e.g. damages, cracks, unexpected wear, corrosion, backlash, noises, condition of lubrication, leaks, tilting, misalignment, resonance behaviour, imbalance, etc).

The inspection of the plant shall be in the form of a visual and functional inspection of the relevant sub-assemblies in terms of the recurring period inspection. The visual inspection shall be performed at close proximity.

All the inspection steps shall be geared to the requirements in the examined maintenance specification for the plant requiring inspection. Compliance with the threshold values stated in the type approval can

be provided in the form of suitable records, including proof of origin, and shall be examined by the official expert.

The official expert is expected to have interdisciplinary interaction with other official experts, where warranted.

The following shall apply in such a case:

- The inspection of the compliance of the relevant, performed maintenance measures shall be carried out on the basis of the maintenance reports from the company performing the maintenance.
- The foundation shall be examined with regard to the required earth surcharge (load), condition of the surfaces in the visible area, concrete spalling and concrete cover, condition of the concrete backfill and the sealing joint, inadequate water drainage, etc.
- The tower structure shall be examined for damages with regard to stability (e.g. corrosion, cracks, spalling in the supporting steel / concrete structures, deformation, gaps, faulty welded joints).
- The tower structure shall be inspected for damages with regard to stability or unauthorised modifications compared with the approved design.
- The tower tensioning into the foundation and the foundation itself will undergo a visual inspection at close proximity.
- Compliance with the relevant threshold values and conditions stated in the type approval for the tower and foundation shall be inspected, insofar as this is technical possible for the official expert.
- The rotor blades shall be inspected at close proximity, both externally and internally (if accessible) with regard to relevant damages to the surface and for structural defects in the body of the blade (e.g. cracks on bonded bridges, de-lamination, etc.).
- The external lightning protection equipment on the rotor, motor and tower inclusive of the connection to the foundation earth electrode shall be examined to ensure they are free of defects.
- The system controls and the electrical equipment will undergo a visual inspection with regard to all connections, fasteners, condition of insulation, proper installation, discolouration and accumulation of dirt.
- A visual and slackness inspection shall be performed as a minimum for scheduled, pre-tensioned bolted connections.
- During the function testing, the safety and adjusting devices as well as the sensors and the system management shall be examined for their operability and observance of the safety-relevant threshold values, provided this is technically possible for the inspector.
- It is necessary to examine whether any unauthorised modifications were performed on the wind turbine generator system as compared to the approved design.

Existing working papers with detailed information on the examination scope must be obtained for the official expert from the BWE e.V. Experts Forum.

If required or if the wind turbine generator system displays any relevant abnormalities, the official expert must perform additional, appropriate inspections or require the operator to do these. These may include:

- Core extraction
- Video endoscopy
- Measurement of the relative movement / tower base internal force variables
- Measurement of tower tilt / natural frequency
- Observation well for recording groundwater level
- Wind measurements to ascertain location-dependent conditions
- Examination of rotor imbalance

7. Inspection report

The results of the recurring periodic inspection are recorded in a written inspection report, which must contain at least the following information:

- Name of examining official expert and other persons present
- Manufacturer, model and serial number of wind turbine generator system and main components
- Location and name of operator of wind turbine generator system
- Operating hours and energy output of wind turbine generator system
- Date of commissioning
- Date and weather conditions on day of inspection
- Unique inspection number
- Page numbering and scope of examinations
- Description of scope of examinations
- Deviations from expected scope of examinations
- Comments and discovered abnormalities
- Summary of examination results
- Indication of next inspection date

The report must draw the operator's attention to the fact that the timely examination of all the defects with safety relevance must be documented and that the operator must archive any appropriate records throughout the entire service life of the wind turbine generator system.

8. Measures

The official expert will specify the time-frames for professional repairs for any ascertained defects in terms of the recurring periodic inspections in the report and in the inspection document.

The operator must provide proof of the performed repair to the official expert with appropriate records and document same; these must comply with the requirements of the DIBt directive for Wind Power Generator Systems, 2012 Version. The content and scope of the repair work shall be examined by the official expert and noted in the inspection report.

The operator is obliged to keep the documentation on repairs performed as a result of stability-relevant requirements throughout the complete service life of the wind turbine generator system and to keep these available for the next recurring periodic inspection.

In the event of the discovery of any relevant abnormalities in terms of the above, the official expert shall inform the wind turbine generator system's operator that he must immediately shut down the wind turbine generator system.

A re-commissioning on the basis of a prior shut-down is conditional on the official expert's approval/clearance to the operator following completion of the performed rectification of defects.

As a rule, the official expert is not obliged to pass on any information or reports to third parties. This may not apply in the case of imminent danger.

9. Inspection results and inspection document

The official expert shall provide a written statement on the current condition within the context of the inspection report, especially if abnormalities are present, which may indicate that the stability of the wind turbine generator system is fully or partially at risk or if the motor and rotor blades are producing direct hazards.

The inspection results on the inspection scope must be broken down as follows:

No faults were discovered at the time of inspection,

- **which fully or partially endanger the stability of the wind turbine generator system**
- **produced due to direct dangers by the motor / due to direct dangers by the rotor blades**

Faults were discovered at the time of inspection.

- **The operation of the wind turbine generator system may resume subject to the following requirements: (Indication of measures and time-frames for implementation)**
- **A resumption of the operation of the wind turbine generator system is not recommended: (Brief justification)**

The official expert shall prepare a inspection document for the operator at his request as proof of the completed recurring periodic inspection based on the guidelines contained in the **Annex 1**. This inspection document, which is only valid in connection with the aforementioned inspection report, is intended for presentation to government agencies, etc.