TAPS - 2000

Type Approval - Provisional Scheme

Provisional Type Certification Scheme
For
Wind Turbine Generator Systems In India

Ammended in April 2003

Ministry of New and Renewable Energy
Block 14, C G O Complex, Lodhi Road,
New Delhi – 110 003

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Questions concerning Provisional Type Certification Scheme may be addressed to:

Mr. A. Senthil Kumar
Unit Chief Incharge - Standards & Certification
Centre for Wind Energy Technology (C-WET)
657/1A2, Velachery -Tambaram Main Road
Pallikaranai
Chennai – 600 100
Tamil Nadu

Phone: +91 44 22463982 / 22463983 / 22463984 / 22463988 (Dir)
Fax: +91 44 22463980

CHAPTER – 1

INTRODUCTION

1.0 INTRODUCTION

Indian wind energy sector has been developing into the main stream of industrial activity with active participation of the private sector. About fifteen Wind Turbine (WT) manufacturers/suppliers with foreign collaborations either as joint ventures or with technology transfer arrangements are installing Wind Turbines (WTs) in India. These manufacturers/suppliers, with a few exceptions, are normally supplying WTs of the types provided by their principals, which are certified by Internationally accredited Certification Bodies. However, these certificates are issued based on the European site conditions and approval schemes/technical criteria of the country in which they are carried out. In addition, the turbines installed in India undergo major/minor changes to suit the Indian conditions. Therefore, all the major stakeholders of the industry expressed the need for establishing the testing facilities and certification procedures in the country.

In view of this, Ministry of New and Renewable Energy (MNRE) has established Centre for Wind Energy Technology (C-WET), as an autonomous institution of Government of India, registered as a society under the Tamil Nadu Societies Registration Act- 1975, at Chennai, Tamil Nadu. C-WET has five units namely, Research and Development (R&D), Wind Resource Assessment (WRA), Wind Turbine Testing (WTT), Standards & Certification (S&C) and Information, Training & Commercial Services (IT&CS) to support all the areas of the wind energy sector. The Wind Turbine Test Station, an integral part of C-WET, is being established as a Project covering the WTT and S&C Units with the technical support and financial assistance of DANIDA, Denmark. RISO National Laboratory (RISO), Denmark, was appointed by DANIDA, as a Technical Consultant of this Project.

MNRE has been issuing guidelines and recommendations periodically to the wind energy sector, to address the issues related to maintaining quality of the WTs installed in India. As per the guidelines dated 24.05.1999, it was stated, "Certification by foreign agencies will not be required henceforth ; manufacturers of WTs will provide self-certification about the quality and performance of their equipment ; this self certification procedure will be followed till such time that Testing/ Certification facilities are established within the country". While the establishment of C-WET in terms of infrastructure and training is in progress, the Wind Turbine Testing Station, the facility for the Testing and Certification is simultaneously made partly operational to meet the immediate needs of the wind energy sector in the areas of testing and certification provisionally. In this context, a provisional scheme namely, "Type Approval - Provisional Scheme (TAPS)", for provisional certification and corresponding requirements of provisional type testing and measurements, is formulated in consultation with RISO. The Wind Energy Sector may now avail this facility for provisional type testing and provisional type certification till the formation and issue of final Type Approval Scheme (TAS) and formal accreditation.

TAPS is intended to meet the requirements of manufacturers/suppliers, wind farm developers, financial institutions, insurance companies, State Electricity Boards, State Nodal Agencies and other related Government /regulatory bodies.

TAPS aims to promote procedures and requirements for the establishment of uniform codes, standards and technical criteria for design, manufacturing and operation of WTs. TAPS comprises of principles, procedures, requirements and the technical criteria for certification of WTs in India, addressed to applicants and others involved in the scheme. TAPS is formulated in line with national and international rules, codes and standards relevant for certification of WT. In TAPS, technical requirements have been framed for topics, which have not been covered currently by the existing standards in India. The procedures and requirements for obtaining the necessary approvals and certificates for manufacturing system (production and installation) evaluation including quality management system, which the WT manufacturer/supplier must comply with, are described in TAPS. The requirements of aspects to be fulfilled and the corresponding documentation requirements are also described.

TAPS will be applicable only to the grid connected, horizontal axis WT of the rotor swept area greater than 40 m^2.

The procedures in TAPS have been formulated in consultations/ discussions with Indian Wind Turbine Manufacturer's Association (IWTMA).

Compliance with TAPS and certificate issued by C-WET to this effect do not absolve any person, organisation or corporation, of the responsibility for following and adhering to all applicable guidelines, procedures, rules, regulations, and protocols.

In the following Chapters, both Type Approval and Type Certification have the same meaning.

TAPS has four Chapters. The first Chapter deals with "Introduction" and the second Chapter deals with "Approval And Organisation". The third and fourth chapters deal with "Definitions" and "Provisional Type Certification". The "List of Acts, Standards and Guidelines", which are applicable to wind energy sector and TAPS, is given as "References". The necessary details connected with TAPS are given in "Annexures".

CHAPTER – 2

APPROVAL AND ORGANISATION

2.0 APPROVAL AND ORGANISATION

2.1 Guidelines

The introduction of TAPS enables the manufacturers/suppliers of WTs to comply with and to document the compliance with the rules in force for Type Approval/certification of WTs.

TAPS is valid for the inland WT and is applicable only to the grid connected, horizontal axis WT with the rotor swept area greater than 40 m^2.

2.2 Scope of TAPS

The following is the scope of TAPS:

- TAPS covers the whole WT up to and including WT terminals and from the terminals to the grid.
- TAPS covers the whole process covering design, manufacturing and installation.
- Type certification for the design of the wind turbine is based on verification of documentation supplied by the WT supplier, if necessary, supplemented by independent calculations, tests and surveillance inspections.
- Quality of the manufacturing and installation of WTs shall be ensured by review of the manufacturer's QMS. The QMS shall preferably be certified for compliance with ISO 9001-2000.
- TAPS ensures compliance with the current safety requirements.

2.3 Basis for Approval

The sections dealing with technical aspects are based on existing national and international codes and standards like International Electrotechnical Commission (IEC), which are relevant to the WT sector. A list of acts, standards and guidelines, which are applicable to wind energy sector and TAPS, is given in "References".

Deviations if any from TAPS, must be clearly documented by the manufacturer/supplier in full, with all necessary references, however, ensuring that the safety requirements and quality aspects are thoroughly and completely fulfilled, the proof of which must be included in the documentation. The Certification Body may accept such deviations, after the evaluation of the same.

2.4 Organisation of the Approval Scheme

2.4.1 Ministry of New and Renewable Energy (MNRE)

TAPS is issued by MNRE as a part of its guidelines to facilitate the wind energy sector.

2.4.2 C-WET

The Standards and Certification Unit of C-WET, which is the Type Certification Body, is the implementing agency of TAPS. The Type Certification Body has the following main tasks.

- To verify the complete documentation provided by the manufacturer/supplier, as per the details furnished in the Chapter- 4 and issue the Provisional Type Certificate, as per the format given in Annexure–6.
- To carry out spot checks of the WTs certified by C-WET, in order to check compliance with the type certified WT. The spot check will normally be carried out along with verification of the safety test, under category I certification, before issue of certificate or during the validity period of the certificate. For WTs under going Category II and Category III certification the spot will be carried out during the validity period of the certificate.
- To carry out survey of damages as a part of investigating agency, when referred by MNRE.
- To disseminate information about TAPS and basis for approval to the users when ever required.
- To participate in international co-operation concerning certification, test procedures and standards for the WT area to enable updating TAPS.
- To improve the TAPS, which includes the incorporation of experiences gained from Testing and Certification and to obtain necessary approval from MNRE.

2.5 Contract and other clauses

2.5.1 Contract between C-WET and Applicant

C-WET will enter into contract with the WT manufacturer/ supplier (applicant) for the purpose of Provisional Type Certification. Details on scope and extent of the work, procedures and time frame, etc are included in the contract.

2.5.2 Storage of Documentation

C-WET will keep all the relevant documents/material for at least 5 years after the expiry of latest certificate issued.

2.5.3 Confidentiality

Complete confidentiality shall be maintained by C-WET on the documents submitted by WT manufacturer/supplier.

2.5.4 Complaints

MNRE is the appellant authority over the decisions made by C-WET according to the basis of approval given in TAPS.

2.5.5 Surveillance inspection

C-WET may conduct surveillance inspection on the installed WT, certified according to TAPS, in order to check compliance with the specifications of TAPS. This is in addition to the inspections carried out by C-WET or authorised agency in connection with the processing of the TAPS, including the production, maintenance and product and installation Certificates.

2.5.6 Accountability

TAPS does not absolve the manufacturer/supplier from their product and other responsibilities.

2.6 Date of introduction of procedures for Certification

Provisional Certification to WT as per TAPS will come into effect from the date of issue of guidelines from MNRE.

TAPS will be in effect till the final Type Approval Scheme (TAS) for certification of WT come into effect.

2.7 Corrective actions

The Type Certification Body shall be informed if, from log-book data or other information brought to the attention of the certificate holder, the WT subjected to PTC is shown not to function according to the design specifications and other criteria relevant to the certificate.

Incidents where the safety of a WT or the surroundings are involved that are known to the certificate holder, shall be reported to the Type Certification Body without delay.

If after preliminary evaluation the Type Certification Body determines a serious defect affecting the safety of the WT subjected to PTC, the Certificate shall be immediately suspended. The Type Certification Body shall subsequently carry out a thorough evaluation of the defect. This evaluation shall result in either reaffirmation or withdrawal of the Certificate.

2.8 Validity of the Certificate

The certificate will normally be valid for a specified period of app. 1 year, however, it can vary from case to case depending on the out standings.

CHAPTER – 3

DEFINITIONS

3.0 DEFINITIONS

For the purpose of TAPS, the following definitions are adopted from IEC. However, some of the definitions related to Certification system are modified to suit for Provisional Type Certification and Testing.

3.1 Accreditation:

Procedure by which an authoritative body gives formal recognition that a body is impartial and technically competent to carry out specific tasks such as certification, tests, specific types of tests etc.

Note: Accreditation is awarded following successful assessment and is followed by appropriate surveillance.

3.2 Applicant:

Entity applying for provisional certification

3.3 Brake (WT):

Device capable of reducing the rotor speed or stopping rotation

3.4 Certificate holder:

Entity holding a provisional certificate after the certificate is issued.

Note: This entity may not be the original applicant but nevertheless is responsible for maintenance of the certificate.

3.5 Certification Body:

Body that conducts provisional certification of conformity

3.6 Certification system:

System that has specific rules for procedure and management to carry out certification of conformity

3.7 Control system (WT):

Subsystem that receives information about the condition of the WT and/or its environment and adjusts the turbine in order to maintain it within its operating limits.

3.8 Cut-in wind speed (V_{in}) :

Lowest mean wind speed at hub-height at which the WT starts to produce power

3.9 Cut-out wind speed (V_{out}):

Highest mean wind speed at hub-height at which the WT is designed to produce power

3.10 Design limits:

Maximum or minimum values used in a design

3.11 Dormant failure (also known as latent fault):

Failure of a component or system which remains undetected during normal operation.

3.12 Electrical power network:

Particular installations, substations, lines or cables for the transmission and distribution of electricity.

Note: The boundaries of the different parts of this network are defined by appropriate criteria, such as geographical situation, ownership, voltage, etc.

3.13 Emergency shutdown (WT):

Rapid shutdown of the WT triggered by a protection system or by manual intervention

3.14 Environmental conditions:

Characteristics of the environment (altitude, temperature, humidity, etc.) which may affect the WT behaviour.

3.15 External conditions (WT):

Factors affecting operation of a WT, including the wind regime, the electrical network conditions, and other climatic factors (temperature, snow, ice, etc.)

3.16 Extreme wind speed:

Highest average wind speed, averaged over *t* seconds, that is likely to be experienced within a specified time period of N years (”recurrence period”: N years)

Note: In this standard recurrence periods of N = 50 years and N = 1 year and averaging time intervals of t=3 sec. and t=10 min are used. In popular language, the less precise term ”survival wind speed” is often used. In this standard, however, the WT is designed using extreme wind speeds for design load cases.

3.17 Evaluation for conformity:

Systematic examination of the extent to which a product, process or service fulfils specified requirements

3.18 Fail-safe:

Design property of an item which prevents its failures from resulting in critical faults

3.19 Final evaluation report:

Report containing the results of conformity evaluations relating to Provisional Type Certification. It is the basis for the decision to issue the Provisional Type Certificate

3.20 Gust:

Temporary change in the wind speed

Note: A gust may be characterised by its rise –time, its magnitude and its duration.

3.21 Horizontal axis WT:

WT whose rotor axis is substantially parallel to the wind flow

3.22 Hub (WT):

Fixture for attaching the blades or blade assembly to the rotor shaft

3.23 Hub-height (WT):

Height of the centre of the swept area of the WT rotor above the terrain surface

3.24 Inspection:

Systematic examination of the extent to which a product, process or service fulfils specified requirements by means of measuring, observing, testing or gauging the relevant characteristics

3.25 Installation:

Process that encompasses on site fabrication, assembly, erection and commissioning

3.26 Manufacture:

Process that encompassess fabrication and assembly in a workshop

3.27 Manufacturer:

Entity manufacturing the WT or, where relevant, main components of the WT.

3.28 Maximum power (WT):

Highest level of net electrical power delivered by a WT in normal operation.

3.29 Mean wind speed:

Statistical mean of the instantaneous value of the wind speed averaged over a given time period which can vary from a few seconds to many years.

3.30 Nacelle:

Housing which contains the drive-train and other elements on top of a horizontal axis WT tower.

3.31 Normal shutdown (WT):

Shutdown in which all stages are under the control of the control system

3.32 Operating limits:

Set of conditions defined by the WT designer that govern the activation of the control and protection system.

3.33 Power output:

Power delivered by a device in a specific form and for a specific purpose.

Note (WT): The electric power delivered by a WT.

3.34 Protection system (WT):

System which ensures that a WT remains within the design limits.

3.35 Rated power:

Quantity of power assigned, generally by a manufacturer, for a specified operating condition of a component, device or equipment.

Note (WT): Maximum continuous electrical power output which a WT is designed to achieve under normal operating conditions.

3.36 Rated wind speed (V_r):

Specified wind speed at which a WT's rated power is achieved

3.37 Reference wind speed (V_{ref}):

Basic parameter for wind speed used for defining WT classes. Other design related climatic parameters are derived from the reference wind speed and other basic WT class parameters

Note: A WT designed for a WT class with a reference wind speed V_{ref}, is designed to withstand climates for which the extreme 10 min average wind speed with a recurrence period of 50 years at WT hub-height is lower than or equal to V_{ref}..

3.38 Resonance:

Phenomenon appearing in an oscillating system, in which the period of a forced oscillation is very close to that of free oscillation.

3.39 Rotor speed (WT):

Rotational speed of a WT rotor about its axis

3.40 Support structure (WT):

Part of a WT comprising the tower and foundation

3.41 Surveillance:

Continuing monitoring and verification of the status of procedures, products and services, and analysis of records in relation to referenced documents to ensure specified requirements are met

3.42 Survival wind speed:

Popular name for the maximum wind speed that a construction is designed to withstand.

Note: Design conditions instead refer to extreme wind speed.

3.43 Swept area:

Projected area perpendicular to the wind direction that a rotor will describe during one complete rotation.

3.44 TAPS - 2000

Type Approval – Provisional Scheme (TAPS) –2000 is a scheme for provisional certification and corresponding requirements of provisional type testing and measurements. TAPS will be in use till the formation and issue of final Type Approval Scheme (TAS) and formal accreditation. In this document, TAPS is written in place of TAPS – 2000. The reader may treat that TAPS is synonymous to TAPS - 2000.

3.45 Turbulence intensity:

Ratio of the wind speed standard deviation to the mean wind speed, determined from the same set of measured data samples of wind speed, and taken over a specified period of time.

3.46 Turbulence scale parameter:

Wave length where the non-dimensional, longitudinal power spectral density is equal to 0.05.

Note: The wave length is thus defined as $A_1 = V_{hub}/f_0$*, where* $f_0 S_1 (f_0)/\sigma_1^2 = 0,05$

3.47 Provisional Type certificate:

Document issued upon the successful completion of provisional type certification

3.48 Provisional Type certification:

Procedure by which a Certification Body gives written assurance that a WT type conforms to specified requirements, provisionally.

3.49 Provisional Type testing:

Action of carrying out provisional tests for a given WT type according to specified procedures

3.50 Ultimate limit state:

Limit states which generally correspond to maximum load carrying capacity (ISO 2394).

3.51 Upwind:

In the direction opposite to the main wind vector.

3.52 Wind speed:

At a specified point in space the wind speed is the speed of motion of a minute amount of air surrounding the specified point.

Note: The wind speed is also the magnitude of the local wind velocity (vector).

3.53 Wind Turbine(s) – WT(s)

System which converts kinetic energy in the wind into electrical energy.

3.54 Wind velocity:

Vector pointing in the direction of motion of a minute amount of air surrounding the point of consideration, the magnitude of the vector being equal to the speed of motion of this air "parcel" (i.e. the local wind speed).

Note: The vector at any point is thus the time derivative of the position vector of the air "parcel" moving through the point.

3.55 WT type:

WT of a common design, materials and major components, subject to a common manufacturing process and uniquely described by specific values or ranges of machine parameters and design conditions

3.56 Yawing:

Rotation of the rotor axis about a vertical axis (for horizontal axis WT only)

3.57 Yaw misalignment:

Horizontal deviation of the WT rotor axis from the wind direction

3.58 Cyclones

Cyclonic storms in sea gradually reduce in intensity as they approach coastal regions. The zone of influence generally extends up to 60 kms in land.

Note : This effect of reduction on land is already reflected in basic wind speeds as specified by IS 875.

CHAPTER – 4

PROVISIONAL TYPE CERTIFICATION

4.0 PROVISIONAL TYPE CERTIFICATION

4.1 Introduction

The objective of this Chapter, viz., Provisional Type Certification (PTC) is to describe the categories of certification, the requirements to be fulfilled by the manufacturer/supplier and the methodology for issuing a provisional type certificate. The PTC would confirm that the WT type subjected to PTC is designed and documented, as per specific standards, design assumptions, design principles and other technical requirements. PTC would assess whether the WT type manufactured is in conformity with the design as described in the design documentation and on the basis of Manufacturing System Evaluation conducted by the System Certification Body as per IEC WT 01. PTC applies to a series of WT manufactured under the same design.

Provisional Type Certificate is issued after performing the technical evaluation of the WT (WT type), based on the verification of the manufacturer's/supplier's documentation of the WT, as per the TAPS prepared in line with IEC WT 01 and IEC 61400 -1 with the modifications to IEC 61400 – 1 to incorporate the Indian conditions, as given in Annexure-2 and additional codes and standards chosen by the designer. However, the details of additional codes and standards applied by the designer shall be submitted to the Type Certification Body for it's agreement. The documentation for design, manufacture, installation, operation and maintenance of a WT must be prepared by the manufacturer/supplier of the WT in a complete and unambiguous manner, in order to satisfy the requirements of TAPS. The evaluation may also be supplemented by provisional type tests/measurements, in accordance with the technical criteria formulated under the three categories of PTC. The outline of these three categories is mentioned below. Each category is described in detail in sections 4.3 to 4.5.

Category - I: PTC for WT already possessing type certificate or approval.

Category - II: PTC for WT already possessing type certificate or approval, with minor modifications/changes, including provisional type testing/measurements at the test site of C-WET.

Category - III: PTC for new or significantly modified WT including provisional type testing/measurements at the test site of C-WET.

In situations where the existing type certificates or type approvals of the WTs applied for category-I or II certification have expired, the existing certificate may be accepted when sufficient documentation for the validtity of the certificate are supplied. This documentation shall include :

- The manufacturer's legal rights to the design of the WT.
- Documentation explaining the reasons for not having a valid type certificate or type approval.
- Documentation regarding all damages, occurrences and operational problems.
- Detailed list of installations in India and elsewhere.
- Documentation as stated in TAPS annex 3.

C-WET will carry out inspection of one or more WTs of the type in order to ensure compliance with the certified WT type and to assess the condition of the WT.

4.2 External Conditions

4.2.1 General

The external conditions detailed in this document, applicable to all the above three categories of PTC, shall be considered in design of a WT.

WTs are subjected to environmental and electrical conditions, which may affect their loading, durability and operation. In order to ensure the appropriate level of safety and reliability, the conditions of environmental, electrical, operational and soil parameters must be considered in the design and also explicitly stated in the design documentation. This design documentation must be submitted by the manufacturer/supplier to the Certifying Body.

The environmental conditions are divided into wind conditions and other environmental conditions.

The WT subjected to PTC for installation in India should be designed using representative environmental and other design conditions. The design should comply with the requirements specified in IEC 61400 – 1 and modifications on external conditions to IEC 61400 – 1, to incorporate the Indian conditions, as given in Annexure-2.

The following documentation for environmental and other conditions must be included for PTC:

- Environmental conditions (wind conditions, park influence, soil conditions, corrosion environment, temperatures, humidity, dust, lightning, earthquake, ice formation, and ice loads, etc.).
- Specification of the WT's foundation.
- Conditions for transport and installation.
- Design life of the WT.

4.2.2 WT Classes

According to IEC 61400-1, WT is classified into five classes viz., I, II, III, IV and a special class S. The normal and extreme conditions which are to be considered in design according to WT classes are prescribed in the same standard. A WT class is defined in terms of wind speed and turbulence parameters. The values of wind speed and turbulence parameters for a WT class, are intended to represent the characteristic values of many different sites and do not give a precise representation of any specific site.

The manufacturer must submit the basic parameters and other important parameters used in the design, as detailed in IEC 61400-1. The design lifetime of the WT should be at least 20 years.

4.2.3 Wind Conditions

A WT should be designed to withstand safely the wind conditions defined for its WT class, as defined in IEC 61400–1, with the modifications given in Annexure-2.

The design documentation, which contains the clearly specified design values of the wind conditions, must be submitted.

Both normal and extreme wind conditions which are to be considered, may be seen from IEC 61400–1/ IS 875.

4.2.4 Other Environmental Conditions

Environmental (climatic) conditions other than wind can affect the integrity and safety of the WT, such as thermal, photochemical, corrosive, mechanical, electrical or other physical action. Moreover, combinations of climatic parameters given may increase their effect.

At least the following other environmental conditions shall be taken into account and the action taken must be stated in the design documentation:

- Temperature
- humidity
- air density
- solar radiation, including ultraviolet radiation
- rain, hail, snow and ice
- chemically active substances
- mechanically active particles
- lightning
- earthquakes and
- salinity

The climatic conditions for the design shall be defined in terms of representative values or by the limits of the variable conditions. The probability of simultaneous occurrence of the climatic conditions shall be taken into account when the design values are selected.

Variations in the climatic conditions within the normal limits, which correspond to a one year return period shall not interfere with the designed normal operation of a WT.

The requirements for normal and extreme environmental conditions shall meet the conditions specified in IEC 61400-1, with the modifications given in Annexure-2.

4.2.5 Electrical power network conditions

The normal conditions to be considered in design of the WT are furnished in the Annexure-2.

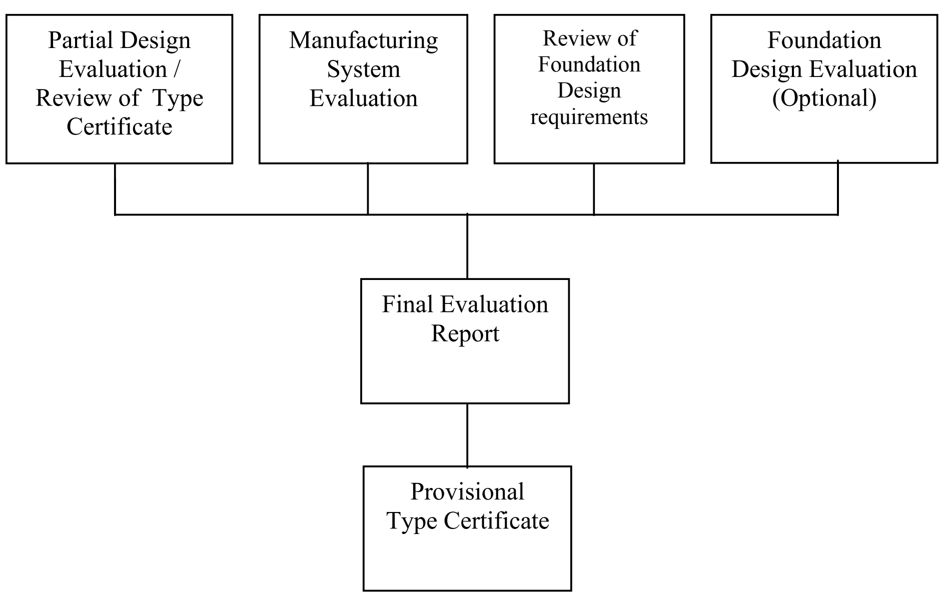
4.3. Provisional Type Certification: Category - I

4.3.1 General

The WT types, which possess a type certificate or approval from an accredited Certification Body, fall under this category.

If any minor changes/modifications are introduced in the design, the manufacturer shall submit documentation on all design changes. The magnitude and effect of these changes will be evaluated by the Type Certification Body. The WT types will be placed under this category, if the changes do not alter the safety/load conditions of the approved /certified WT type.

PTC of this category consists of the following modules:



4.3.2 Partial Design Evaluation / Review of Type Certificate

The type certification/approval systems of Denmark, The Netherlands, Germanisher Loyds and the IEC are recognised by TAPS and the certificates issued according to these four systems, are recognised by PTC. Detailed references of the recognised systems are given in Annexure-1. WT types possessing type certification/approval according to any system other than these four will be considered for evaluation, provided that the supplier or manufacturer furnishes the complete details of the system. Provisional Type Certificate will be issued by Type Certification Body, based on a review of the validity of the type certificate or approval and its applicability in India by evaluating conformity with the external conditions for India, given in Annexure-2. Verification of safety system, specifications and spot check will be carried out in a wind farm site before or after the issue of the certificate. However, the requirement, scope and extent of the verification of safety system shall be decided on case to case basis.

4.3.3 Manufacturing System Evaluation

The purpose of manufacturing system evaluation is to assess if a specific WT type is manufactured in conformity with the design documentation, on the basis of the system evaluation carried out by the System Certification Body. This evaluation shall include the following elements:

- quality system evaluation; and
- manufacturing inspection.

Manufacturing system evaluation shall meet the requirements as per section 8.4 in IEC WT 01

The requirement for evaluation of the quality system is satisfied if the quality system is certified to be in conformance with ISO 9001- 2000. This system certification shall be carried out by an accredited body that operates according to ISO/IEC Guide 17062.

If the quality system is not certified, the applicant shall get the system evaluation done by an accredited System Certification Body, as per clause 8.4 of IEC WT 01 and submit the evaluation report to the Type Certification Body. The Type Certification Body shall assess the system of the applicant based on this report to verify whether the system meets the requirements specified in section 8.4 in IEC WT 01,.

While the manufacturing system inspection is carried by the System Certification Body, it may be witnessed by Type Certification Body.

4.3.4 Review of Foundation Design Requirements

The foundation design requirements are given in Annexure-5. The manufacturer/supplier shall submit the documentation on foundation design requirements.

4.3.5 Foundation Design Evaluation

The purpose of the optional foundation design evaluation is to enable the inclusion of one or more foundation designs in the Provisional Type Certificate, as selected by the applicant. The foundation design included in PTC, shall meet the requirements given in IEC WT 01.

The Type Certification Body shall issue a conformity statement based on satisfactory evaluation of the foundation design evaluation report.

4.3.6 Final Evaluation

The purpose of final evaluation is to prepare documentation of the findings of all operating bodies involved in the evaluation of the elements of the Provisional Type Certificate. The final evaluation report shall be prepared by the Type Certification Body.

4.3.7 Provisional Type Certificate

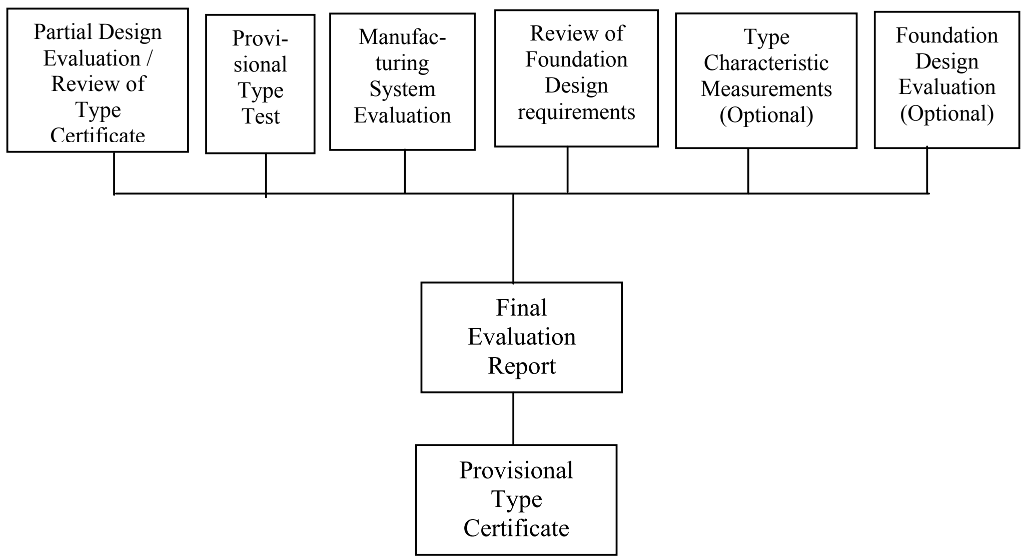
The Type Certification Body, Standards and Certification (S&C) unit of C-WET, will issue a Provisional Type Certificate based on satisfactory evaluation for completeness and correctness of the final evaluation report. This Certificate is valid for the WT type specified in the Certificate, for a specified period. The specifications may include alternative tower design and configurations. The allowable combinations of alternatives shall be clearly identified. The format of the provisional type certificate is given in Annexure-6.

4.4. Provisional Type Certification: Category - II

4.4.1 General

The WT types, which possess a type certificate or approval from an accredited Certification Body, fall under this category. The requirements to fulfill Category II is same as Category – I, supplemented with provisional type test and other measurements.

PTC of this category consists of the following modules:



4.4.2. Details and Requirements

As mentioned in 3.4.1, the details and requirements of the following Modules are same as Category-I:

- Partial Design Evaluation / Review of Type Certificate
- Manufacturing System Evaluation
- Review of Foundation Design Requirements
- Foundation Design Evaluation

4.4.3 Provisional Type Testing

4.4.3.1 General

The purpose of provisional type testing is to provide data which are needed to verify power performance of the WT and aspects that are vital to safety and need additional experimental verification and aspects that cannot be reliably evaluated by analysis. The provisional type testing consisting of the following tests, conducted according to IEC standards- modified for Indian conditions will be reviewed, by the Type Certification Body.

- Safety and function test

- Power performance measurements
- Yaw efficiency measurement and
- Report on static test of the blade edgewise and flapwise (conducted by any laboratory in abroad)

The detailed test program shall be made by the applicant and be subject to approval by the Type Certification Body on a case by case basis.

The safety and function test shall be witnessed by the Type Certification Body.

The power performance measurements shall be carried out in accordance with IEC 61400-12, modified for Indian conditions. In addition,

a) measurements of the following need to be recorded:

- The rpm of the WT has to be measured as a 10 min. average value

and,

b) Corrections for both air density (value as given in Annexure – 2), grid frequency and rpm shall be calculated and mentioned in the Test report

The provisional type testing shall be carried out by an accredited testing laboratory /the Testing unit of C-WET pending accreditation. The Type Certification Body shall verify that the party conducting the test complies with the criteria of ISO/IEC 17025.

The Type Certification Body shall require that the testing and the test results should be documented in a test report. The provisional type test report shall conform to the requirements of ISO/IEC 17025 and relevant standards used to define the test requirements. In addition, test report shall include a description of :

- the WT with identification by means of serial number (and control system software revision number (s), where applicable);

- any differences between the WT under the test and with the corresponding documentation submitted for Certification ; and

- any significant unexpected behaviour

Attestation by the Operating Body shall be clearly marked on the final provisional type test report(s)

This test report shall be evaluated by the Certification Body to ensure that the tests have been carried out in accordance with the approved detailed test program and aspects required for certification are documented properly. By carrying out inspection, the Type Certification Body shall verify that critical personnel safety features have been satisfactorily implemented in the installed WT to be tested.

A satisfactory evaluation is concluded with a conformity statement, issued by the Type Certification Body. The signatories of the conformity statement shall be different from the persons responsible for the test reports, attestation of the tests and accreditation of the test laboratories.

4.4.3.2 Test Reports

Provisonal type test reports shall conform with the requirements of ISO/IEC 17025 and relevant standards used to define the test requirements. In addition, test reports shall include a description of:

- identification of the WT by means of serial number (and control system software revision number (s), where applicable);
- any differences between the WT under the test and with the corresponding documentation submitted for Certification
- any significant unexpected behaviour

Attestation by the operating body shall be clearly marked on the final provisional test report(s).

4.4.3.3 Provisional Type Test Conformity Statement

A satisfactory evaluation is concluded with a conformity statement, issued by the Certification Body. The signatories of the conformity statement shall be different from the persons responsible for the test reports, attestation of the tests and accreditation of the test laboratories. The conformity statement shall specify:

- the tests carried out
- the test standards applied
- identification of the test reports

4.4.4 Type Characteristic Measurements

Power quality measurements

The power quality measurements mainly deal with the reactive power measurements. The reactive power of the WT must be recorded according to IEC 61400-21 along with power performance.

The reactive power would be specified in a table as ten-minute-average values as a function of the ten-minute-average output power for 0,10,…90,100 % of the rated power. The reactive power at maximum continuous power shall also be specified.

The measurement method is according to the procedure laid down in section 7.4 of IEC 61400-21 .

4.4.5 Final Evaluation

The purpose of final evaluation is to prepare documentation of the findings of all operating bodies involved in the evaluation of the elements of the Provisional Type Certificate. The final evaluation report shall be prepared by the Type Certification Body.

4.4.6 Provisional Type Certificate

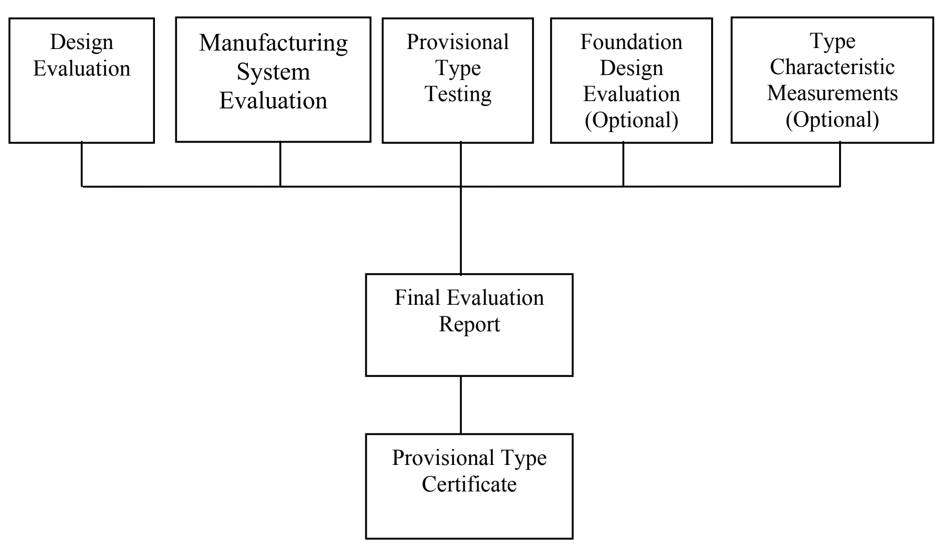
The Certification Body, Standards and Certification (S&C) unit of C-WET, will issue a provisional type certificate based on satisfactory evaluation for completeness and correctness of the final evaluation report. This certificate is valid for the WT type specified in the certificate. The specifications may include alternative tower design and configurations. The allowable combinations of alternatives shall be clearly identified. The format of the provisional type certificate is given in Annexure-6.

4.5 Provisional Type Certification : Category - III

4.5.1 General

New or significantly modified WT types, which do not possess a type certificate, fall under this category.

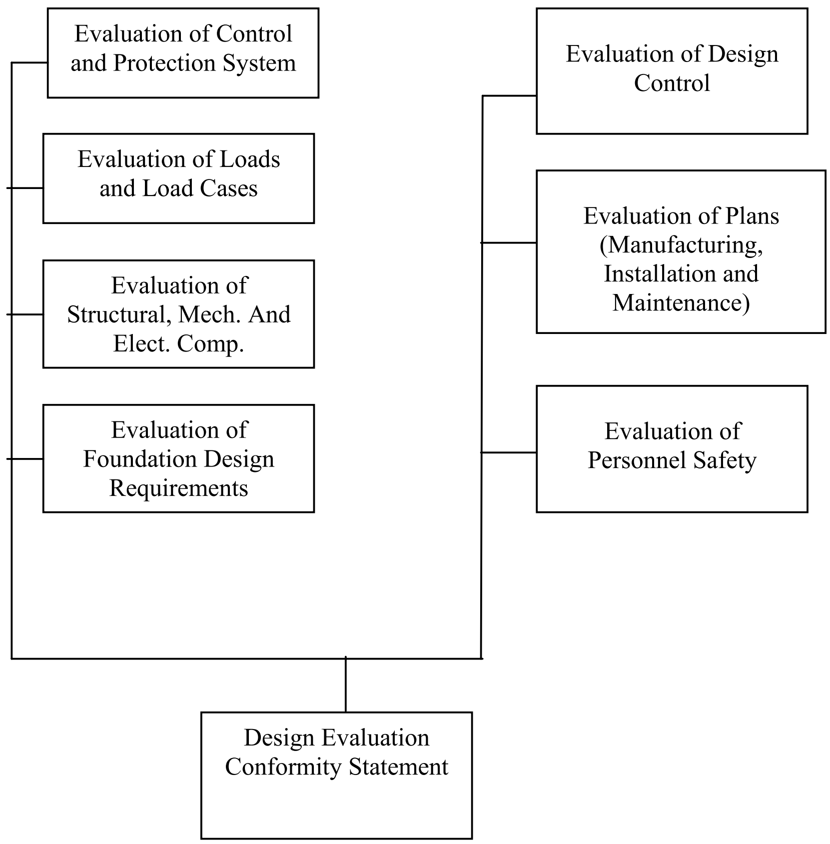
The principles of the certification shall follow IEC WT 01. PTC of this category consists of the following modules:



4.5.2 Design Evaluation

4.5.2.1 The purpose of design evaluation is to examine whether the WT type is designed and documented in conformity with the design assumptions, specific standards and other technical requirements. An applicant shall submit all documentation, as detailed in Annexure-3, to the Certification Body to carry out design evaluation. The design evaluation comprises of the following modules:

r



4.5.2.2 Design Control

The Type Certification Body shall evaluate the quality procedures used to control the design process. Design control procedures shall be required to:

- comply with ISO 9001 - 2000 sub-clause 4.4, Design Control; and

- include control of documents such that the revision status of every document is clear to all parties.

4.5.2.3 Control and protection System

The certification Body shall evaluate the documentation of the control and protection system. A wind Turbine must be equipped with control and protection system. The manufacturer/supplier shall submit documentation for the control system and detailed documentation for the protection system.

Manual or automatic mode of operations/interventions should in no case compromise the function of the protection system. Settings of the control and protection system shall be protected against unauthorised interference.

Any device meant for manual operation/intervention should be clearly visible and identifiable, with suitable name plates written in the regional and English languages and positioned at appropriate places, where necessary.

A WT should always be equipped with two independent systems for protection, such that single failure in the sensing or the activation parts of the control system should not lead to a malfunction or complete failure of the protection system.

The supplier/ manufacturer of the WT should submit a formal statement confirming that the requirements of TAPS are complied with. In connection with the PTC, supplier/ manufacturer of the WT, must submit the documentation on the control and protection systems. Further, the Certification Body carries out spot checks to confirm the details provided in the documentation.

The requirements for control and protection systems must comply with IEC 61400 –1.

4.5.2.4 Loads and Load Cases

Design calculation details considering the following loads should be submitted:

- inertial and gravitational loads
- aerodynamic loads
- operational loads
- other loads such as wake loads, impact loads etc,

For, calculations of loads and load cases, the applicant shall refer IEC 61400-1.

For stall regulated WT with a rotor diameter less than 31 m, the methods for load calculation, which are given in Annexure-4, may be used.

Grid outage is considered to be a normal situation. Therefore, combination of extreme loads and grid outages shall be considered. See also IEC 61400-1, section 6.5. This means that wind coming from any direction shall be considered.

4.5.2.5 Structural, Mechanical and Electrical Components

Structural Design

The structural design should meet the requirements of IEC 61400 –1. WT structural design shall be based on documentation of the structural integrity submitted by the manufacturer/supplier for the following load carrying components:

- blades
- hub
- main shaft
- gear box
- bearings and bearing housings
- nacelle frame
- yaw system
- tower and
- joints between various components

The ultimate and fatigue strength of structural members shall be documented by calculations and / or tests, to demonstrate the structural integrity of the WT with the appropriate safety level. In general, the ultimate strength will be verified for all the above components and fatigue strength will be verified only for certain components, where consequences in connection with failure is severe. For e.g., the ultimate design calculations will be done to verify the design of the gearbox supports. Further, the scope of verification does not include the design of the gears etc.

Design and structural analysis shall be carried out by the manufacturer/supplier based on ISO 2394.

An acceptable safety level shall be ascertained and verified by calculations and / or tests to demonstrate that the design loading will not exceed the relevant design limits. Calculations shall be performed using appropriate methods. The descriptions shall include evidence of the validity of the calculation methods or references to suitable verification studies. The load level in any test shall reflect the factors of safety in the corresponding calculation.

Mechanical Components

The mechanical systems of the WT may include:

- elements of the drive train such as gear box(es), shaft(s) and coupling(s)
- auxiliary items such as brake(s), blade pitch control(s), yaw drive(s)

Auxiliary items may be driven either by electrical or hydraulic or pneumatic means. The mechanical system shall meet the requirements detailed in IEC 61400-1.

Electrical Components

The electrical system of the WT comprises all electrical equipment installed in the WT upto and including the WT terminals . The electrical system shall meet the requirements detailed in IEC 61400-1. However, capacitors which are essential to meet the power factor requirements are dealt in detail below:

Capacitors

The power capacitors used in WT should be designed and made to with stand the conditions according to the standards IEC 60831-1, and IEC 60931-1, except the requirements of voltage level, current limits, hormonics and the temperature, which are furnished below. The reactive power compensation of 0.25-0.35 of the rated active power at rated production should be provided by the capacitors.

i) Over voltages

Routine tests: The capacitors should with stand with no permanent puncture or flash over when subjected to the routine tests for short term over voltages of power capacitors as described in clause 9 of IEC 60831-1. However, self healing breakdowns are permitted.

Type tests: The capacitors should with stand with no permanent puncture or flash over when subjected to the type tests for short term over voltages of power capacitors as described in clause 9.2 of IEC 60831-1. However, self healing break downs are permitted.

The capacitors shall be designed to withstand at least 200 times of over voltages higher than 1.15 Un (Un is the rated RMS voltage of the capacitor) in the life of the capacitor .

ii) Current limits

The maximum permissible current in the capacitor is specified in clause 21, IEC 60831-1,:

"Capacitor units shall be suitable for continuous operation at rms line current of 1.3 times the current that occur at rated sinusoidal voltage and at rated frequency, excluding transients. Taking into account the capacitance tolerances of 1.15 C_n, the maximum current can reach 1.5 I_n"

iii) Temperature limits

Capacitors are classified into categories based on temperature level according to IEC 60831-1.

Capacitors shall meet the extreme temperature conditions given in Annexure–2.

iv) Harmonic and interharmonic disturbances

Capacitors shall meet the requirements of clause 37.2.1 of IEC 60831-1:

"Capacitors shall be suitable for continuous operations in the presence of harmonics and interharmonics within the limits required in clauses 2 and 3 of IEC 61000-4-7"

Compatibility level for individual harmonic voltages, THD, THD_w and interharmonics in low voltage networks shall be maintained according to IEC 61000-4-7 (14).

4.5.2.6 Foundation Design Requirements

The foundation design requirements are given in Annexure-5.

4.5.2.7 Evaluation of Plans

The detailed manufacturing plans including manufacturing process for the components of the turbine manufactured by the applicant excluding the sub-contracted /bought-out components, shall be submitted to Certification Body by the manufacturer/supplier. The details on "incoming inspection procedures" for all the materials/components shall also be submitted to Certification Body.

Installation and maintenance plans shall be documented and submitted to Certification Body.

These plans will be evaluated by the Quality System Certification Body in accordance with IEC WT 01.

4.5.2.8 Evaluation of personnel safety

The Certification Body shall evaluate personnel safety aspects in the design documentation (drawings, specifications and instructions for compliance with IEC 61400 –1). In connection with proto-type testing, the Certification Body will make an inspection of personnel safety aspects such as emergency stop button, safety equipment for climbing the tower, emergency light fitted in tower (in the case of tubular tower), safety instructions etc.

Emergency stop buttons shall be so placed that they shall have easy and unhindered access from all normal work areas of the Wind Turbine and they are indicated very clearly.

4.5.2.9 Design Evaluation Conformity statement

A conformity statement will be issued by the Type Certification Body, after the satisfactory evaluation of a design evaluation report. The conformity statement shall include:

- identification of the WT type
- identification of the applicant
- list of IEC 61400 series used
- specification of external conditions with reference to the WT class and other principal data and
- specific reference to evaluation report(s)

4.5.3 Manufacturing System Evaluation

The purpose of manufacturing system evaluation is to assess if a specific WT type is manufactured in conformity with the design documentation, on the basis of the system evaluation carried out by the System Certification Body. This evaluation shall include the following elements:

- quality system evaluation; and
- manufacturing inspection.

Manufacturing system evaluation shall meet the requirements as per section 8.4 in draft IEC WT 01.

The requirement for evaluation of the quality system is satisfied if the quality system is certified to be in conformance with ISO 9001 - 2000. This system certification shall be carried out by an accredited body that operates according to ISO/IEC Guide 17062.

If the quality system is not certified, the applicant shall get the system evaluation done by an accredited System Certification Body, as per clause 8.4 of IEC WT 01 and submit the evaluation report to the Type Certification Body. The Type Certification Body shall assess the system of the applicant based on this report to verify whether the system meets the requirements specified in section 8.4 in IEC WT 01,.

While the manufacturing system inspection is carried by the System Certification Body, it may be witnessed by Type Certification Body.

4.5.3 Provisional Type Testing

4.5.4.1 General

The purpose of provisional type testing is to provide data which are needed to verify power performance of the WT and aspects that are vital to safety and need additional experimental verification and aspects that cannot be reliably evaluated by analysis. The provisional type testing consisting of the following tests, conducted according to IEC standards- modified for Indian conditions will be reviewed, by the Type Certification Body.

- Safety and function test
- Power performance measurements
- Yaw efficiency measurement and
- Report on static test of the blade edgewise and flapwise (conducted by any laboratory in abroad)
- Load measurements
- Measurements of natural frequencies

The detailed test program shall be made by the applicant and be subjected to approval by the Type Certification Body on a case to case basis.

The safety and function test shall be witnessed by the Certification Body.

The power performance measurements shall be carried out in accordance with IEC 61400-12, modified for Indian conditions. In addition,

a) measurements of the following need to be recorded:

- The rpm of the WT has to be measured as a 10 min. average value

and ,

b) Corrections for both air density (value as given in Annexure – 2), grid frequency and rpm shall be calculated and mentioned in the Test report

The provisional type testing shall be carried out by an accredited testing laboratory /the Testing unit of C-WET pending accreditation. The Type Certification Body shall verify that the party conducting the test complies with the criteria of ISO/IEC guide 17025.

The Type Certification Body shall require that the testing and the test results should be documented in a test report. This test report shall be evaluated by the Certification Body to ensure that the tests have been carried out in accordance with the approved detailed test program and aspects required for certification are documented properly. By carrying out inspection, the Type Certification Body shall verify that critical personnel safety features have been satisfactorily implemented in the installed WT to be tested.

A satisfactory evaluation is concluded with a conformity statement, issued by the Type Certification Body. The signatories of the conformity statement shall be different from the persons responsible for the test reports, attestation of the tests and accreditation of the test laboratories.

4.5.4.2 Test Reports

Provisonal type test reports shall conform with the requirements of ISO/IEC Guide 17025 and relevant standards used to define the test requirements. In addition, test reports shall include a description of:

- identification of the WT by means of serial number (and control system software revision number (s), where applicable);
- any differences between the WT under the test and with the corresponding documentation submitted for Certification
- any significant unexpected behaviour

Attestation by the operating body shall be clearly marked on the final provisional test report(s).

4.5.4.3 Provisional Type Test Conformity Statement

A satisfactory evaluation is concluded with a conformity statement, issued by the Type Certification Body. The signatories of the conformity statement shall be different from the persons responsible for the test reports, attestation of the tests and accreditation of the test laboratories. The conformity statement shall specify:

- the tests carried out
- the test standards applied
- identification of the test reports

4.5.5 Foundation Design Evaluation

The purpose of the optional foundation design evaluation is to enable the inclusion of one or more foundation designs in the Provisional Type Certificate, as selected by the applicant. The foundation design included in PTC, shall meet the requirements given in IEC WT 01.

The Type Certification Body shall issue a conformity statement based on satisfactory evaluation of the foundation design evaluation report.

4.5.6 Type Characteristic Measurements

4.5.6.1 Power quality measurements

The power quality measurements mainly deal with the reactive power measurements. The reactive power of the WT must be recorded according to draft IEC 61400-21 along with power performance.

The reactive power would be specified in a table as ten-minute-average values as a function of the ten-minute-average output power for 0,10,…90,100 % of the rated power. The reactive power at maximum continuous power shall also be specified.

The measurement method is according to the procedure laid down in section 7.4 of IEC 61400-21 .

4.5.7 Final Evaluation

The purpose of final evaluation is to prepare documentation of the findings of all operating bodies involved in the evaluation of the elements of the Provisional Type Certification. The final evaluation report shall be prepared by the Certification Body.

4.5.8 Provisional Type Certificate

The Type Certification Body, Standards and Certification (S&C) unit of C-WET, will issue a provisional type certificate based on satisfactory evaluation for completeness and correctness of the final evaluation report. This certificate is valid for the WT type specified in the certificate. The specifications may include alternative tower design and configurations. The allowable combinations of alternatives shall be clearly identified. The format of the provisional type certificate is given in Annexure-6.

REFERENCES: **List of Acts, Standards and Guidelines**

Acts:

MNRE regulations for Type Certification of Wind Turbines in India

The Indian Electricity Act, 1910

The Electricity (Supply) Act, 1948

Finance ministry, Govt. of India regarding depreciation

NABL regulations for measuring laboratories.

Standards:

IEC 60831-1: 2002 –11 Ed.2.1 *Consolidated Edition Part 1 – General – Performance, testing and rating – Safety requirements – Guide for installation and operation*

IEC 60931-1: 1996 –11 Part 1 – *General – Performance, testing and rating – Safety requirements – Guide for installation and operation*

IEC 61000-4-7: 2002–08 *Electromagnetic compatibility (EMC)-Part 4-7:Testing and measurement techniques-General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*

IEC 61400-1: (Ed. 2, 1999), *Wind turbine generator systems. Safety requirements*

IEC 61400-12: (1998), *Wind turbine generator systems. Wind turbine power performance testing.*

IEC 61400-21: (xxxx), *Wind turbine generator systems. Power quality requirements for Grid Connected Wind turbines.*

IEC WT 01*: IEC System for Conformity Testing and Certification of Wind turbines*

-Rules and Procedures.

IEC/ISO Guide17025: 1990, *General requirements for the competence of calibration and testing laboratories.*

IEC/ISO Guide 65: 1996, *General requirements for bodies operating product certification systems.*

ISO 2394: 2nd edition 1998, *General principles on reliability of structures.*

ISO 9001 - 2000: *Quality Management Standard*

IS : 875 (Part 3) – 1987, *Code of practice for design loads (other than earthquake) for buildings and structures.*

DS 472(Danish standard): 1st edition may 1992, *Loads and safety of wind turbine constructions.*

NEN 6096/2, Preliminary draft standard 1994, *Regulations for the Type-Certification of Wind turbines: Technical criteria.*

NVN 14400-0: 1999, *Regulations for the Type-Certification of Wind turbines: Technical criteria.*

IS 4326:1993 *Earthquake resistant design and construction of buildings -code of practice.(second revision) (Amendment 1)*

IS 1893: 1984 *Criteria for earthquake resistant design of structures (fourth revision) (Amendent 1)*

IS 325 : 1996 *Three phase Induction motor specifications*

IEC 61400-24 *Wind turbine generator system. Lightning protection.*

Guidelines:

Rules and Regulation, Regulations for the Certification of Wind Energy Conversation Systems, Germanischer Lloyd, 1999

Technical Criteria for the Danish Approval Scheme for Wind Turbines, Danish Energy agency, 1st August 1996.

ANNEXURES

ANNEXURE-1, **Recognised Certification Schemes**

The following certification schemes will be recognised by C-WET certification unit when an accredited certifying body carries out certification.

The Danish Certification Scheme

Technical Criteria for the Danish Approval Scheme for Wind Turbines, Danish Energy Agency, latest edition.

Type Approvals class A and B will be accepted.

The Dutch Certification Scheme

Type Certificate in compliance with Technical Criteria, Preliminary draft of NEN 6096/2 will be accepted.

Type Certificate in compliance with Technical Criteria, NVN 14400-0 will be accepted.

Germanisher Loyds Certification Scheme

Type Certificate in compliance with Rules and Regulations, Germanischer Lloyd, edition 1999, will be accepted

IEC Certification Scheme

Type Certificate in compliance with IEC WT 01 will be accepted

ANNEXURE- 2, External conditions for India

The environmental conditions for India vary across the country. Hence, the environmental conditions for the specific site has to be considered. The following conditions may vary when such other conditions are documented.

Wind conditions

- For normal operating wind conditions (Weibull parameters and Turbulence intensity) references to IEC 61400-1 are done. Assessment of wind conditions for the specific site must be made individually.
- Extreme wind speed conditions shall be referred to in Indian Standard, IS 875 (Part 3) - 1987

Other climatic conditions

- There are no special descriptions of conditions for lightning.
- There are no special descriptions of conditions for hail.
- Ice formation shall not be considered.
- Extreme design temperature range will be in the interval from -5°C to +60°C.
- Humidity up to 99% must be considered.
- Design air density will be minimum 1,20 kg/m^3

Site conditions

- Terrain conditions has to be considered in accordance with IS : 875 (Part 3), 1987
- No special requirements for park effects has to be considered when IEC 61400-1 is referenced
- Objects disturbing the wind has to be considered in accordance with IS : 875 (Part 3), 1987
- Earthquake must be considered when siting in areas with risk of earthquake
- Salt, sand and dust must be considered for the specific site.
- Chemical influences must be considered for the specific site
- Global solar radiation intensity of 1500 W/m^2 must be considered
- Soil parameters have to be specified in the foundation design requirements
- Considerations concerning hill slope has to be made in accordance with IS : 875 (Part 3), 1987

Operational conditions

- Cut out wind speed must be defined
- Extreme yaw error is defined in IEC 61400-1. Normal yaw error must be defined and verified by measurements
- Design lifetime must be minimum 20 years according to IEC 61400-1.
- Normal operating temperature range must be from +0°C to +50°C.
- Voltage level will be +/- 10 % of nominal value
- Frequency level will be - 3 Hz and +1 Hz of nominal value
- Voltage imbalance:
- The ratio of the negative-sequence component of voltage to the positive-sequence component will not exceed 2%.
- Electrical network outages vary from site to site. Hence, the outages shall be reasonably assumed according to the requirements of the site. The minimum number of outages should be assumed to occur as 350 times per year.
- The maximum outage duration for which the wind turbine would be designed shall be at least one week. .

ANNEXURE- 3, **List of documentation**

The object of this annexure is to provide a list of necessary documentation to be submitted by the manufacturer /supplier of the WT, to the Certification Body in connection with the application for PTC. The list of details may provide guidelines for the applicant to able to understand the level of documentation necessary for the evaluation of the WT design. The list does not limit the Certification Body's right to require additional documentation whenever the Certification Body finds it necessary. All documentation has to be supplied in English language.

The list is divided into 3 parts referring to the 3 categories of the TAPS.

Category - I.

Certification based on certificates from other certification bodies and other modules as detailed in 4.3.

Certification based on certificates from other certification bodies.

1. Design documentation

1.1. Type certificate from certifying body

1.2. Design verification report issued by the certifying body as follows:
- 1.2.1. a description of the scope of work carried out by the certifying body
- 1.2.2. the results of the performed evaluations
- 1.2.3. a list of approved drawings
- 1.2.4. a list of approved part lists and specifications
- 1.2.5. a list of test reports
- 1.2.6. a list of requirement specifications
- 1.2.7. a list of WT manuals i.e. O&M manuals and installation manual
- 1.2.8. a register of received documentation

1.3. Certificate for the accreditation of the certifying body including list of methods.

1.4. Deviations in design related to the certified WT design
- 1.4.1. List of any deviations in design.
- 1.4.2. Documentation for all deviations in the design.

1.5. Description of deviations in design conditions in relation to the certified WT.

1.6. Clarification of actions taken in connection with deviations in the design conditions.

1.7. Supplementary documentation as follows:
- 1.7.1. WT description and general specifications
- 1.7.2. Description of the control and safety system including hydraulic circuits, if employed
- 1.7.3. Controller set points list

1.7.4. Test plan for verification of Safety and function test including documentation for power control to the nominal power P_{nom}
1.7.5. Manuals for operation and maintenance
1.7.6. Foundation design requirements

2. Production and installation documentation

2.1. Quality Assurance:
2.1.1. When certified QM system is available:
2.1.1.1. Valid ISO 9001 - 2000 certificate
2.1.1.2. Copy of unabridged latest audit reports
2.1.2. When certified QM system is not available:
2.1.2.1. Copy of quality manual, procedures and instructions.
2.1.2.2. Manual for installation and commissioning
2.1.2.3. Quality Plan of the Manufacturer will focus on:

- Responsibilities
- Control of documents
- Sub-contracting
- Purchasing
- Process control
- Inspection and testing
- Corrective measures
- Quality recordings
- Training
- Product identification and traceability

2.2. List of drawings used for production of the WT in question

2.3. Part list used for production

Category – II

Certification based on certificates from other certification bodies and other modules as detailed in 4.4, including an evaluation of the critical safety and engineering integrity issues.

a) Provisional type test:

In addition to the documentation stated under Category-I, the applicant shall submit reports of the following tests conducted under provisional type test.

- Safety and function test witnessed by C-WET certification unit
- Power performance measurements
- Yaw efficiency measurement and
- Report on Edgewise and Flap wise static tests. The test report shall be from any accredited testing laboratory.

b) Type Characteristic Measurements

Power quality measurements

The power quality measurements mainly deal with the reactive power measurements. The measurements shall be carried out as detailed in 4.4.4.

Category – III

Certification based on provisional type test and other modules as detailed in 4.5, including an evaluation of the critical safety and engineering integrity issues. The validation of the certification will when possible be based on international and Indian standards and guidelines.

a) Provisional type test:

The applicant shall submit reports of the following tests conducted under provisional type test.

- Safety and function test witnessed by C-WET certification unit
- Power performance measurements
- Yaw efficiency measurement and
- Report on Edgewise and Flap wise static tests. The test report shall be from any accredited testing laboratory.
- Load measurements (ref. IEC WT01, Annex C)
- Measurements of natural frequencies

b) Type Characteristic Measurements

Power quality measurements

The power quality measurements mainly deal with the reactive power measurements. The measurements shall be carried out as detailed in 4.5.6.

A detailed list of documentation is given below. Besides this list, documentation for production and installation as described in paragraph 2 of Category-I shall also be submitted.

Analysis of the strength of the WT components against to fatigue failure can in some cases be replaced with requirements for inspection described in the maintenance manual.

Design Documentation for TAPS

			Drawings (Note 1 and 4)	Analysis (Note 2 and 4)	Description (D) Specifications (Sp) Schematics (Sch) (Note 3)	Status/Remarks
1.0	**General Turbine Description**					
	1.1	General Turbine Characteristics and Configuration Description				
		Turbine description and general specifications	•		D, Sp	
		Major component weights and centres of gravity			Sp	
		Operational limits			Sp	
		Electrical power system	•		D, Sch	
		Electrical control system	•		D, Sch	
		Hydraulics and pneumatics	•		D, Sch	
	1.2	External conditions and design class			D	
	1.3	Control and protection philosophy			D	
	1.4	Codes and standards			D	
	1.5	Co-ordinate Systems	•		D, Sch	
2.0	**Control and Protection System**					
	2.1	Description and component specifications including transducers and sensors			D, Sp	
	2.2	Detailed control logic flow chart			Sch	
	2.3	Set point list			Sp	
	2.4	Control system software			D, Sch, Sp	
	2.5	Software release and version control			D	
	2.6	Remote control/ monitoring			D, Sch, Sp	
	2.7	Protection system logic		•	D, Sch	
	2.8	Over speed sensing			Sp,Sch	
	2.9	Overpower/current sensing			Sp, Sch	
	2.10	Vibration sensing			Sp,Sch	
	2.11	Emergency stop button			D,Sch	
3.0						
	3.1	General analysis approach		•	D	
	3.2	Partial safety factors		•	Sp	
	3.3	Validation of calculation models:				
		Analytical		•		
		Comparisons with test data		•		
	3.4	Dynamic behaviour of the system and of individual major components:				
		Mode shapes & frequencies		•		
		Comparisons between predictions and measurements		•		
	3.5	Load cases (from IEC 61400-1 plus other identified cases):				
		Fatigue load cases		•		
		Ultimate load cases		•		
		Failure modes		•		
	3.6	Loads for structural components:				
		Blade		•		
		Hub		•		
		Low speed shaft and bearings		•		
		Mainframe and gearbox structure		•		

			Drawings (Note 1 and 4)	Analysis (Note 2 and 4)	Description (D) Specifications (Sp) Schematics (Sch) (Note 3)	Status/Remarks
		Gearing and drive train (including gen., brake & couplings)		•		
		Tower top/yaw system		•		
		Tower		•		
		Tower connection to foundation		•		
		Foundation		•		
		Other		•		
	3.7	Critical deflection (blade/tower)		•		
	3.8	Foundation Design Requirements		•	D, Sp, Sch	
4.0	**Components**					
	4.1	System Level Descriptions:				
		Assembly drawings	•			
		Material properties			Sp	
		Rotor				
	4.2	Blade:				
		Blade	•	•	Sp	
		Blade/hub joint	•	•		
		Aerodynamic brake system			Sp	
	4.3	Hub:				
		Structure	•	•		
		Pitch system (including power supply)	•	•	Sp	
		Pitch bearing	•	•	Sp	
		Hub/low speed shaft joint	•	•		
	4.4	Low speed shaft:				
		Structure	•	•		
		Bearings		•	Sp	
		Bearing mountings	•	•	Sp	
		Nacelle				
	4.5	Structure:				
		Main frame	•	•		
	4.6	Gearbox:				
		Gearbox/mainframe connection	•	•		
		Gearbox/generator coupling	•	•	Sp	
		Gearing, bearings, cooling, lubrication, shafting & couplings	•	•	Sp	
	4.7	Generator:			Sp	
	4.8	Yaw system:				
		Connections	•	•	D, Sp	
		Tower and Foundation				
	4.9	Tower:				
		Structure	•	•		
		Connections	•	•		
		Openings	•	•		
	4.10	Foundation:				
		Connection to tower	•	•	Sp	
		Other				
	4.11	Brake (maximum & minimum torque rating)	•	•	Sp	
	4.12	Manuals for operation and maintenance			D, Sp	
	4.13	Installation manual			D, Sp	

			Drawings (Note 1 and 4)	Analysis (Note 2 and 4)	Description (D) Specifications (Sp) Schematics (Sch) (Note 3)	Status/Remarks
5.0	**Component Test Reports**					
	5.1	Component Tests - Gearbox. - Generator. - Lightning Arrester - Surge Arrester - Others		•	D	
6.0	**Safety- and function test**					
	6.1	Witnessing of safety test			D	
	6.2	Checking of personal safety aspects including instructions			D	
		Inspection of the WTGS type			D	
	6.3	Checking locking devices	•	•		

Notes:

1) **Drawings** are typically engineering drawings that clearly define dimensions of components or electrical schematics. They can also include material specifications, fabrication instructions or finish specifications when referring to a specific component contained within the drawing.

2) **Analysis** usually refers to engineering calculations such as stress analysis or calculations of structural loads or of electrical loads as well as statistical analysis. Analysis is the basis of specifications for structural, material, electrical and mechanical component requirements. This also includes plots of results and comparisons with test results.

3) **Specifications** (Sp) are written requirements for certain components of the WT. These could include performance and dimensional specifications for a gear-box, finish requirements for gearing, bearing descriptions, electrical demands for electrical components, dimensional requirements for mechanical components, performance specifications for a hydraulic auxiliary power supply or quality documentation.

   Schematics (Sch) are data plots, flow charts, diagrams and other illustrations (electric, pneumatics, and hydraulics).

   Descriptions (D) consist of text describing relevant tasks, functions, components etc.

4) A check mark (•) indicates that Drawings or Analysis are expected in the documentation for the element in the left-hand column.

ANNEXURE- 4, **Simplified method for load calculation**

The simplified method for load calculation is a translation of paragraph 6.3 Load calculation from the Danish standard DS 472.

The dimensioning loads of the wind turbine in the operational mode, production operation, may be calculated according to a simplified method as examined in this guideline, provided that the following requirements are met.

The simplified method gives direct load range distributions for all load cases relating to production operation.

The calculated load range distributions are used to assess the fatigue limit states of the wind turbine. In addition, an ultimate load limit state must be examined, whereby the average value of the parameters studied is combined with the corresponding half-maximum load range found in the load range distribution of the parameter. Furthermore, it is necessary to make clear whether the remaining load cases are of significance either for fatigue or extreme load limit states.

The following assumptions define the type of wind turbine, which may be dealt with by means of simplified calculations:

- the wind turbine shall have 3 blades, generate electricity and be stall-regulated with fixed blade angle, with no hub hinge;
- the wind turbine shall produce electricity by means of an induction generator, connected to the power network at a fixed frequency;
- the wind turbine rotor shall be placed on the windward side (upwind rotor) with a maximum 10° tilt, radius R < 15,5 m, solidity between 5 and 15% and a minimum distance from the blade to the tower during production operation of half of the local tower diameter for the outer half of the blade;
- the defined maximum power of the wind turbine P_{max} may exceed the maximum long-term average power (nominal power) P_{nom} (maximum point on the power curve between V_{min} and V_{max}) by 15% at the most; see figure 1.

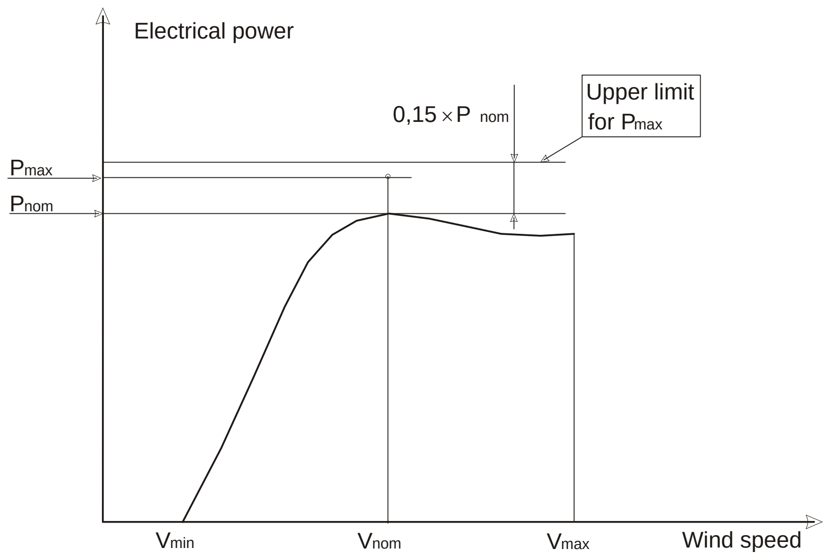


Figure 1. Power curve, P_{max}, P_{nom} and V_{nom}

- the nominal generator power of the electric generator of the wind turbine (rated output according to IEC standards) $P_{nom,g}$ must be at least P_{nom};
- the maximum operating frequency of rotation of the wind turbine $n_{r,max}$ shall be limited, so that $n_{r,max} < 1.05\ n_{r,syn}$, where $n_{r,syn}$ is the operating frequency of rotation corresponding to idling (synchronous frequency of rotation) on the primary generator;
- the yawing speed of the wind turbine shall not exceed $\omega_k = 1°$/second;
- at an arbitrary given wind velocity, V_{10min} the yaw-error in the wind turbine must be distributed with a maximum 10º average yaw-error and a maximum 10º standard deviation;
- the stop wind velocity of the wind turbine V_{max} shall not exceed 25 m/s;
- the lowest blade and tower natural frequencies n_o during operation shall differ from the operating frequency of rotation n_r by at least 10%;
- the lowest natural frequency of the tower for bending shall be less than 2,5 n_r;
- the Weibull k parameter must be between 1,85 and 2,00;
- for wind turbines in wind farms or groups, the distance between wind turbines must be > 5×D.

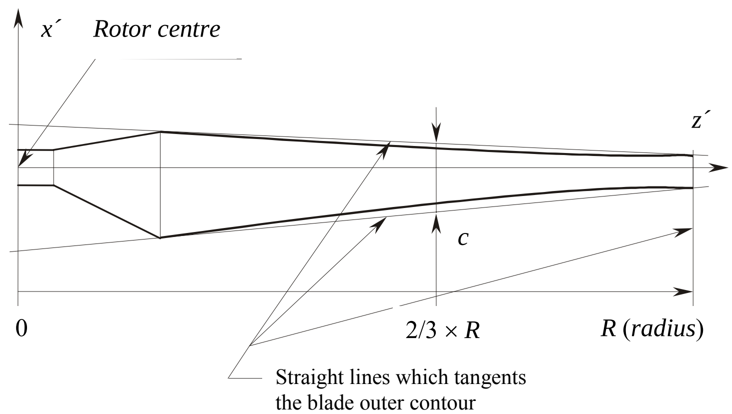


Figure 2. Definition of rotor radius at the 2/3-point and characteristic chord line length

The *characteristic aerodynamic load* value, p_o shall be calculated as a basis for the load calculations. The characteristic load is defined as the y' component of the aerodynamic load per unit of length of the blade acting at the 2/3-point of the blade (i.e. where $r = 2/3R$ and at right angles to the rotor plane, see definition of the rotor co-ordinates system in Table 3 and blade geometry in Figure 2).

p_o is calculated from

$$p_0 = 0.5 \rho W^2 c C_L$$

where

C_L is the lift coefficient at the $^2/_3$-point,
W is the resulting wind velocity,
ρ is 1,28 kg/m^3 = air density,
c is the characteristic chord line length at $^2/_3 R$, see Figure 2.

As lift coefficient the maximum for the blade profile concerned shall be used, but it must be at least $C_L = 1.5$. The resulting wind velocity W shall be determined for blade loads by means of

$$W^2 = (2/3 R * 2 \pi n_r)^2 + Vo^2 = (4.2 n_r R)^2 + Vo^2$$

where

n_r is the rotor frequency of rotation in Hz with the primary generator connected,
R is the rotor radius,

V_0 is the nominal stall wind velocity defined as the lower of the two following wind velocities:

- Nominal wind velocity V_{nom}, or
- 10-min average wind velocity, where just the whole blade is stalled with airflow parallel with the rotor shaft. The wind velocity is defined at hub height.

The wind velocity corresponding to the 10-minute average, at which the stall just

$$V_{0,stall} = 2\pi\, n_r\, R\, tg\,(\alpha_{stall,tip} + \theta_{b,tip})$$

extends to the whole blade, can be determined by means of
where

$\alpha_{stall,tip}$ is angle of attack for the tip profile at max C_L
$\theta_{b,tip}$ is blade angle for tip

As a rule, a linear line load distribution outwards along blade of $p_o r/R$ (triangular load) can be assumed for the *y'* direction. It may be advantageous to replace this with an alternative distribution:

$$P(r) = const * ((2\,\pi\, n_r\, r)^2 + Vo^2)\; c\,(r)\; C_L\,(r)$$

where the local relative wind velocity and the exact chord line distribution along the blade is included. The constant in the expression for *p(r)* is adjusted so that the moment in the rotor centre has the same value as for the distribution $p_0 r/R$, namely $p_0 R^2/_3$.

In the case of fatigue calculations, loads are generally described by means of a constant average value overlaid with an accumulated load range distribution $F_\Delta(N_v)$, (see example in Figure 4).

An accumulated load range distribution is described in terms of a distribution function $F_\Delta(N_v)$. This function is defined in such a way that $F_\Delta(N_v)$ is the load range which is exceeded N_v times in the service life of the wind turbine.

The model used for this presupposes that the blade line loads are divided into two types. The first type (called deterministic) describes the effect of the gravitational force on the rotating blade. The corresponding load range distribution includes only load ranges of one constant size to a number, N_f, which is equal to the total number of rotor revolutions during production operation in the design service life of the wind turbine, t_f. (example Figure 4, Curve b).

The second type (called stochastic) includes all other loads, e.g. variable aerodynamic loads. This type of distribution is described with the help of a standardised load range distribution, with a load distribution $F_{\Delta}(N_v)$ of this type being expressed by means of a dimensioning constant multiplied by the standardised distribution $\hat{}F_{\Delta}(N_v)$ (example Figure 4, Curve a).
The standardised load range distribution is defined by means of

$$\hat{}F_{\Delta}(N_v) = \beta(\log(Nf) - \log(Nv)) + 0.18, \text{ until } F_{\Delta}(N_v) = 2.0\, k_{\beta}$$

where

β is given as $\beta = 0.11\ k_{\beta}\ (I + 0.1)\ (A + 4.4)$,

I is the turbulence intensity at hub height in the direction of the wind at the actual site,

k_{β} is a correction factor for the slope of the distribution,

N_f is given as $N_f = n_c\ t_f\ [\ \exp(-(V_{\min} / A)^k) - \exp(-(V_{\max} / A)^k)]$ = number of widths during the lifetime of the turbine corresponding to the characteristic load frequency,

A,k are scale parameter and shape parameter, respectively, for the Weibull distribution,

n_c is the characteristic load frequency,

t_f is the design service life of the wind turbine.

The correction factor k_{β} for the bias in the distribution is usually 1. Only for calculating the rotor pressure F_y (see Table 4) shall a standard range distribution with k_{β} = 2.5 be used. In connection with wind farms or groups it is necessary to consider how far the park configuration affects the average wind velocity (and therefore the A parameter) and the turbulence intensity I. The formula for N_f, takes into account how often wind velocity is between V_{min} and V_{max}.

The standardised load range distribution is shown in Figure 3. The distributions, which are defined for different loads by means of this standardised load range distribution, are described as a constant times the standard distribution. There are three parameters, which affect a given standard distribution:

N_f is the total number of ranges in the service life of the wind turbine. A change in N_f will involve parallel displacement of the distribution along the frequency axis,

β changes the slope of the load distribution, but the greatest loads remain unchanged,

k_{β} also changes the bias. In this case it also increases the greatest loads.

The dimensioning constant, which is multiplied by the standard distribution, is independent of N_v, but does depend on wind turbine geometry, climate etc. This means that if, for example, it is necessary to find range distributions as the integral out along the blade of load range distributions, the integration variable is contained in the dimensioning constant, while the standard distribution $\hat{}F_{\Delta}(N_v)$ act as a constant as far as the integration is concerned.

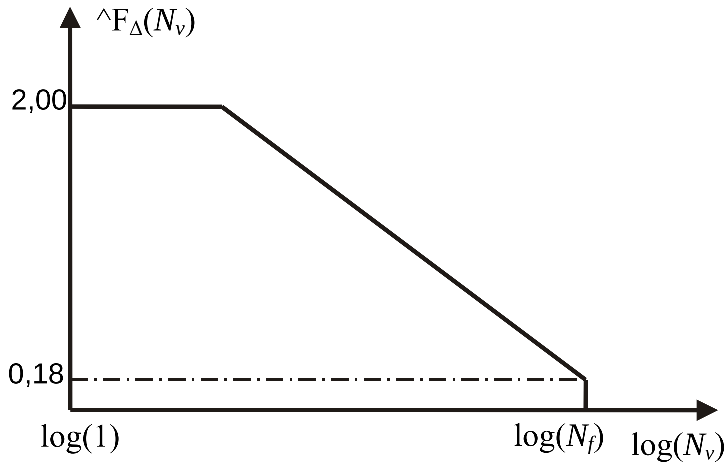


Figure 3. Standardised stochastic load range distribution

When load range distributions are calculated for sums of loads of the two types, stochastic and deterministic, the following shall apply. Deterministic loads are compounded first, with the following dependency of time *t* being assumed (the blade vertically upwards when *t* = 0):

$$P^d(t, P^d_{\Delta c}, P^d_{\Delta s}, n_c) = \bar{P} + ½\, P^d_{\Delta c} \cos(2\,\pi\, n_c\, t) + ½\, P^d_{\Delta s} \sin(2\,\pi\, n_c\, t)$$

When stochastic loads are compounded with deterministic or other stochastic loads, it is necessary to be conservative in the calculations, as the phase relationships for stochastic loads are not known. This means that the following model may be used. Load ranges from each of two distributions are added directly one at a time. The largest from each distribution is taken first, and then the smaller ones are taken in succession according to size. Each load range is included once and only once. Therefore, it is assumed that each load range in the first distribution occurs the same time as the largest still unused range from the second distribution.

Figure 4 shows the accumulated load distribution for p_x. Curve a) is the stochastic range distribution, the number of ranges $N_a = 3\ N_r$. Curve b) is the deterministic (gravity induced) distribution with constant range 2 *mg* and number of ranges $N_b = N_r$. The solid-line curve c) is the sum distribution, as it can be shown that the conservative summation method specified above can be achieved by direct addition of the two accumulated distribution functions a) and b) for frequencies $< N_r$. (This is only correct for accumulated distributions). For frequencies $> N_r$, the sum is equal to the stochastic one, because the deterministic ranges are "used up".

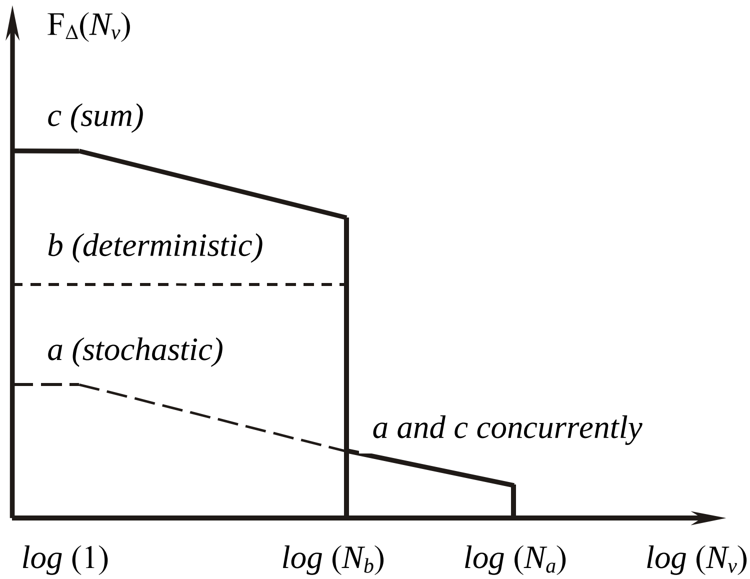


Figure 4. Compounding of stochastic and deterministic loads

Blade loads

Table 2 sums up the blade line loads used according to blade co-ordinates (Table 1). However, the deterministic contribution is divided into a cosine and a sine element, which must be used when compounding several deterministic loads. The last series in the table indicates the characteristic load frequency for the load type in question.

Table 1. Description of blade co-ordinates

Direction	Description
x'	Rotation direction and perpendicular to the main shaft
y'	Parallel to main shaft in wind direction
z'	Following the blade length perpendicular to the main shaft

Table 2. Blade line load

	Average value	Load range distributions		
Direction		Deterministic		Stochastic
	$\overline{p}$	$P^{d}_{\Delta c}$	$P^{d}_{\Delta s}$	P^{s}_{Δ}
x'	$2M_{nom}/(3R^2)$	0	+2 mg	$0.3F_{\Delta}(N_v)p_o$
y'	$1.5\ p_o r/R$ *	0	0	$F_{\Delta}(N_v)p_o r/R$
z'	$(2\pi n_r)^2 mr$	-2 mg	0	0
Frequency n_c		n_r	n_r	$3\ n_r$

* but $\overline{P}_{y'} = Po$ *for* $r \geq 2/3\ R$.

In table 2 is

$m = m(r)$	the blade mass per unit of length at the distance r
g	gravitational acceleration
$M_{nom} = P_{nom}/2\pi n_r \eta_o$	nominal driving torque corresponding to nominal power
η_o	nominal efficiency (≤0.9)
$F_{\Delta}(N_v)$	standardised distribution, see above
$\Delta c, \Delta s$	indices for load ranges for cosine and sine elements respectively

Hub Loads

When the internal loads on the rotor hub are calculated, allowance should be made for blade loads with reciprocal phase lag of 120°. For the purposes of the calculation, the hub is assumed to be rigidly fixed at the shaft attachment, where the rotor loads are crucial.

It should be pointed out that the rotor loads are defined in the fixed *x,y,z* system (Table 3) and therefore must be converted to the hub system, with allowance being made also for dead weight.

Rotor Loads

The rotor loads are defined on the basis of the characteristic aerodynamic line load p_o, the standardised load range distribution form $F_{\Delta}(N_v)$ as well as the nominal driving torque M_{nom} defined in table 2.

Tabel 3. Description of blade co-ordinates

Direction	Description
X	Horizontal direction and perpendicular to the main shaft
Y	Parallel to main shaft in wind direction
Z	"Vertical" and perpendicular to the main shaft

Average value, amplitude and frequency of rotor loads are given in table 4, with the individual load components being separately compounded as

$$F = \bar{F} + \tfrac{1}{2} F_{\Delta} \cos(2 \pi n_c t)$$

where

t is time in seconds.

Table 4. Rotor loads

Load F	**Average** $\bar{F}$	**Range** F_{Δ}	**Frequency** n_c	**Resonance frequency (oscillation form),** n_0
F_x	0	0	0	
F_y	1.5 p_0R	0.5 $p_0RF_{\Delta}(N_v)$	stat.: n_T rot.: $3n_r$	n_T (tower, bending)
F_z	-Mg	0		
M_x	0	$\frac{1}{3} k_R p_0 R^2 F_{\Delta}(N_v)$	3 n_r	n_R (rotor, tilt, asym.)
M_y**	0.5 M_{nom}	0.45 $p_0R^2F_{\Delta}(N_v)$	3 n_r	
M_z	0	$\frac{1}{3} k_R p_0 R^2 F_{\Delta}(N_v)$	3 n_r	n_R (rotor, yaw, asym.)

** It may be assumed that M_y is always between 0 and 1,3 M_{nom}

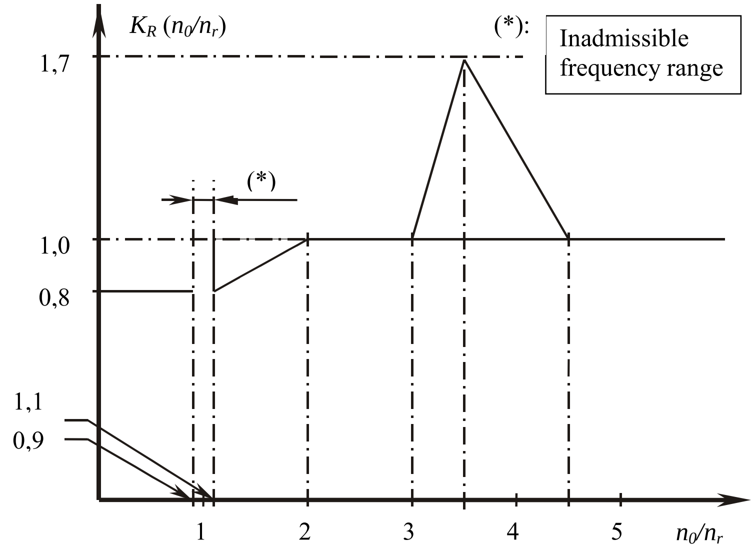


Figure 5. Response amplification

In table 4 and figure 5 are

M	rotor mass,
k_R	is a correction factor which for M_x and M_z takes into account the position of relevant resonance frequencies in relation to the frequency content of the external influences. The k_R factor is read from Figure 5 as a function of the resonance frequency,
n_o	is lowest resonance frequency for the oscillation form in question,
n_R	is lowest resonance frequency for the collective asymmetric rotor oscillation at standstill, where one blade oscillates out of phase to the two others. The oscillation will link with nacelle/tower, for which reason its frequency in yawing and tilting respectively may be different,
n_T	is lowest resonance frequency for tower in bending ($<2.5\ n_r$).

It should be pointed out that, as far as gearbox calculations are concerned, it is necessary to use a duration curve for shaft moment. For example, it may be conservatively assumed here that the moment is constant at the upper limit indicated.

Note that for F_y it is necessary to use a modified standard distribution with the bias β multiplied by $k_\beta = 2.5$ as mentioned in the definition of the standard distribution above. The two frequencies which are indicated for F_y are used for F_y distributions in, respectively, the stationary ($n_c = n_T$) and the rotating part of the wind turbine ($n_c = 3\ n_r$), thus taking into account, that the oscillations are damped when it is transmitted from the rotating part to the stationary part.

When the load range distributions are determined, it is necessary to be conservative in calculations when adding the individual components and distributions, as discussed in connection with Figure 4.

In the calculations shown, the wind load on the tower can be assumed to have been included.

ANNEXURE- 5, **Foundation Design Requirements**

FOUNDATION DESIGN REQUIREMENTS

INTRODUCTION

The turbine is subjected various loads like forces in lateral direction, transverse direction, torsional moment, tilting moment etc., during its lifetime. The loads considered at various parts of the wind turbine as mentioned in the design documentation, will be verified in the Design evaluation / Partial design evaluation module according the Category of certification of TAPS-2000. The loads considered at the tower bottom form the basis for calculating the loads acting on the foundation. Hence, for the design of foundation the tower bottom loads are to be considered as basis.

FOUNDATION DESIGN REQUIREMENTS

The Certification body shall evaluate the foundation design requirements according to IEC WT01. The purpose of evaluation of the foundation design requirements is to verify the loads considered in foundation design compared with the tower bottom loads calculated in the design documentation. The tower bottom loads are to be considered as characteristic loads acting on the foundation.

The loads considered in the foundation design are to be provided as mentioned in the Table below. The applicant must provide the data taking reference to the co-ordinate system shown below.

The data provided in the Table only should only be used in the designing the foundation.

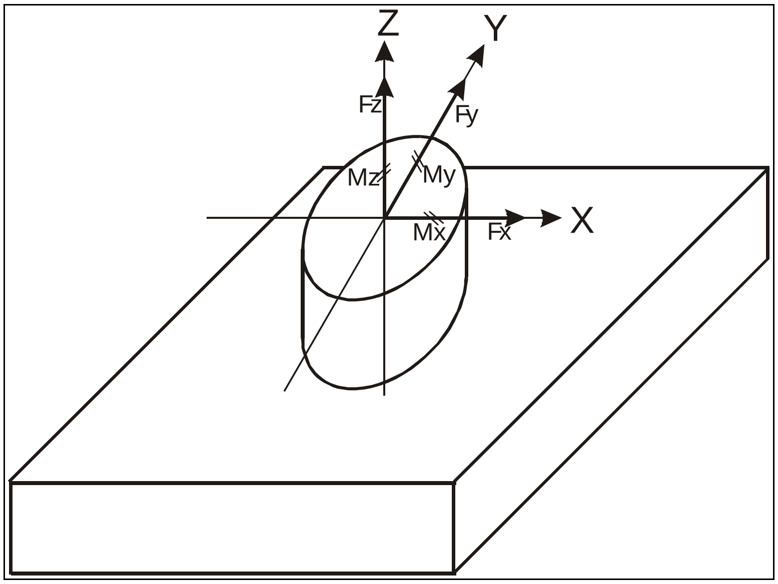
Guidelines

Besides the loads the foundation designer needs information's concerning geometric interface, soil conditions etc. as given below:

- Reference to local site specific and structural codes if any.
- Information's about earth quake.
- Information's about requirements for flatness, level, bolt pattern and tolerances etc.

Furthermore the designer of the foundation must take action to avoid any misunderstanding concerning responsibility for the connection between the tower and the foundation (bolts, fishplates, poured steel involucres etc.). Normally the tower designer are responsible for the connection itself and the foundation designer are responsible for the connection to the foundation.

Figur 1, Coordinate system and load components



Foundation design loads for WTG type:						
Description:				Characteristic load[1]	Partial coefficient for load[2]	Design load
Extreme loads	Force	Horizontal in X-direction	$F_{e,x}$			
		Horizontal in Y-direction	$F_{e,y}$			
		Vertical in X-direction	$F_{e,z}$			
	Moment	Bending around X-axis	$M_{e,bx}$			
		Bending around Y-axis	$M_{e,by}$			
		Torsion around Z-axis	$T_{e,bz}$			
Fatigue loads(*)	Force	Horizontal in X-direction	$F_{f,x}$			
		Horizontal in Y-direction	$F_{f,y}$			
		Vertical in X-direction	$F_{f,z}$			
	Moment	Bending around X-axis	$M_{f,bx}$			
		Bending around Y-axis	$M_{f,by}$			
		Torsion around Z-axis	$T_{f,bz}$			

(*) Slope of S-N curve and Equivalent Number of Cycles shall be reported.

[1] The loads can be found in the load document from the designer of the wind turbine or in the evaluation report from the certifying body. Please note that the loads given in these documents often include load partial coefficients.

[2] Load partial coefficients from building codes must be used together with material partial coefficient from the same building code series.

ANNEXURE- 6, **Format of Provisional Type Certificate**

PTC - (Number)
Provisional Type Certificate

This certificate is issued to

Company
Address

for the WT

XXXX

The certificate attests compliance with “Type Approval - Provisional Scheme – 2000 (TAPS-2000)” – Provisional Type Certification Scheme for WT in India, Category - yy, concerning the design and manufacturing system. It is based on the following reference documents:

DE-(Number)	:	Design Evaluation Conformity Statement
dated	:	dd.mm.yy
PTT-(Number)	:	Provisional Type Testing Conformity Statement
dated	:	dd.mm.yy
MSC-(Number)	:	Manufacturing System Conformity Statement
dated	:	dd.mm.yy
FDE-(Number)	:	Foundation Design Evaluation Conformity Statement
dated	:	dd.mm.yy
TC-(Number)	:	Type Characteristics Conformity Statement
dated	:	dd.mm.yy
ER-(Number)	:	Final Evaluation Report
dated	:	dd.mm.yy

The conformity evaluation was carried out according to TAPS - 2000 – Provisional Type Certification Scheme for WT in India. The WT type is specified on page 2 of this certificate. Changes in the system design or the manufacturer’s quality system are to be approved by (Certification Body). Without approval the Certificate loses its validity.

This Provisional Type Certificate is valid until dd.mm.yy.

(Location), dd.mm.yy.
ee/ss (Certification Body)

Signature(s)

PTC - (Number)
Provisional Type Certificate, Page 2

WT Type Specification:

Machine parameters:

Model	
WT manufacturer and country	
IEC WT class	
Rated power	[kW]
Rated wind speed Vr	[m/s]
Rotor diameter	[m]
Hub height(s)	[m]
Hub height operating wind speed range	V_{in}-V_{out}[m/s]
Design lifetime	[y]

Wind conditions:

Characteristic turbulence intensity I_{15} at V_{hub} = 15 m/s	[-]
Annual average wind speed at hub height V_{ave}	[m/s]
Reference wind speed V_{ref}	[m/s]
Average inclined flow	[deg]
Hub height 50-year extreme wind speed V_{e50}	[m/s][3]

Electrical network conditions:

Normal supply voltage and range	[V]
Normal supply frequency and range	[Hz]
Voltage imbalance	[V]
Maximum duration of electrical power network outages	[days]
Number of electrical network outages	[1/year]

Other environmental conditions (where taken into account):

Normal and extreme temperature ranges	[°C]
Relative humidity of the air	[%]
Air density	[kg/m^3]
Solar radiation	[W/m^2]
Description of lightning protection system	
Earthquake model and parameters	
Salinity	[g/m^3]

Major components:

Blade type	[-]
Gear box type	[-]
Generator type	[-]
Tower	[-]
Foundation	[-]

Manuals:

Installation manual	[-]
Operation and maintenance manual	[-]
Repair manual	[-]

[3] The extreme design wind speed gives possibilities for installation of the wind turbines in areas with Basic wind speed below xx m/s. See also IS 875 (Part 3) - 1987