

## HARMONISATION OF EUROPEAN WIND TURBINE CERTIFICATION

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**ABSTRACT:** The present situation in wind turbine certification - characterised by a co-existence of different wind turbine certification systems - hampers the trade of wind turbines in Europe. This situation has many negative implications on the implementation of wind energy in political, commercial, environmental and legal sense. The EWTC project was set up in the FP4 (Joule 3 Programme) by four certification bodies in Europe to tackle this problem on the "technical level". The project partners have carried out parallel certifications to determine specific interpretation differences in design evaluation of wind turbines, using IEC 61400-1 and IEC WT 01 as a common basis. The partners have streamlined their conclusions towards common Guidelines for Design Evaluation of Wind Turbines to be used together with the existing standards and regulations. The project team also formulated recommendations on how to implement the Guidelines in a formal way in Europe.

**Keywords:** wind turbine certification, European harmonisation.

### 1. PRESENT ISSUES IN HARMONISATION OF WIND TURBINE CERTIFICATION

The present issues, which make a certification harmonisation necessary in the European Union, are mainly situated in the following areas:

- **environmental:** The practical implementation of the European Directives in the area of wind energy calls for uniformity in wind turbine projects assessment in order to uniformly deal with safety and noise and other technical issues;
- **political:** A uniform basis for assessment of wind turbine projects is needed to ensure that there is an equal quality basis all over Europe in view of incentives (subsidies, tax incentives etc.)
- **commercial:** In the interest of investors, financiers, insurance companies, developers etc. it is necessary to demonstrate in a uniform way that wind turbines exceed (or at least reach) their expected lifetime. In this respect, uniform certification should be the unambiguous basis for due diligence of wind energy projects. Manufacturers should be able to sell turbines all over Europe, which will be facilitated by uniformly accepted certification. More workforce in the certification bodies should be available to cover the demand for certification without delays, which will be facilitated if the process is more open and uniform.
- **legal:** In this respect also a uniform basis for assessment of wind turbines is needed to ensure that there is an equal basis for building permits / Type Approval all over Europe;
- **technical:** Uniform certification is necessary in order to ascertain that wind turbine type testing is uniform all over Europe.

The present situation of variety in certification systems thus has a lot of negative implications in all these areas. Harmonisation of certification is expected to have considerable effect on further wind energy development in Europe.

### 2. EWTC AIMS AT UNIFORM WIND TURBINE CERTIFICATION

The European institutes involved in wind turbine certification have carried a joint research project funded by the European Commission in the FP4 (Joule 3) programme to work towards a harmonised wind turbine certification in the European Union. This project - European Wind Turbine Certification (EWTC), contract JOR3-CT98-0265 started in May 1998 and was completed in April 2001.

The main objective of EWTC was to develop a common practice in order to overcome the different interpretation possibilities of the present standards used in certification i.e. the IEC 61400-1 [1] which addresses technical and safety requirements for wind turbines and the IEC-WT-01 [2] which addresses the certification systems. The use of these documents - which contain a lot of sub-optimal compromises - in practice lead to different interpretations and hence to different conclusions in the evaluation of wind turbine design. As a result, wind turbines are not universally accepted. The ultimate objective is to work towards a uniform wind turbine certification all over Europe.

The basic method followed in the EWTC project was to identify the variation in interpretation by in parallel carrying out three "certification cases". These cases were intended to identify Based upon the differences encountered the project partners have worked out solutions for agreement.

The project was carried out by a Consortium consisting of Germanischer Lloyd Windenergie, Risø National Laboratories together with Det Norske Veritas, Centre of Renewable Energy Sources CRES and Energy research Centre of the Netherlands ECN together with CIWI Holland. The coordination was done by ECN. The manufacturers Enercon GmbH (D), Nordic Wind Power (S) and Jeumont Industrie (F) provided the material for the case studies in terms of design documents and access to a wind turbine for testing.

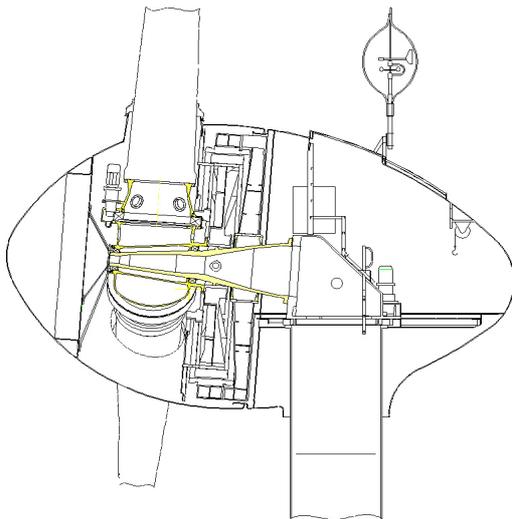
The wind turbine industry has been invited within the project to express its view on the efficiency of

certification procedures. It has been the aim of the project partners to adjust the uniform procedure optimally to the interests of the industry. The findings of the initial stage of the project have been described in references [3] and [4].

### 3. APPROACH OF EWTC

The basic approach of the EWTC project consisted of identifying the specific mutual differences in certification method of the partners by carrying out certification of identical wind turbines and based upon the resolution of the differences encountered drafting of specific interpretation guidelines and unified requirements to be followed by the European certification bodies.

Within the round robin certifications every project partner has certified the same set of design documents for the same wind turbine. This procedure has been carried out for three different turbines using IEC 61400-1, ed. 2 [1] for loads, safety and design and IEC -WT-01 [2] for the overall procedure to obtain a Conformity Statement for Design Evaluation or a Type Certificate.



**Figure 1:** The Enercon E-40/6.44 wind turbine was subject to the Case Study certification 1 of EWTC

In order to obtain realistic results from the case certifications a careful approach has been worked out. First, in the selection of the wind turbines selection criteria have been applied in order to ensure that state-of-the-art design methods have been applied by the manufacturer and furthermore that sufficient discussion material would emerge from the case studies.

The type certification has been carried out in several steps following the different modules and elements in IEC-WT-01. The modules are design evaluation, manufacturing evaluation and type testing. The first step in design evaluation is the evaluation of loads and safety concept being the basis for the design of the turbine. The second step is the evaluation of the strength and adequacy of the components and systems. Each step is concluded by each partner with a certification report, sufficiently detailed to allow a comparison of the evaluation work of the different partners.

The certification evaluations have been carried out according to the specific practices of every certification body involved. However in order to minimise the “disturbance” for the manufacturer having to deal with four parallel investigators, every certification case was co-ordinated by a case co-ordinator who streamlines the contact with the manufacturer. From the comparison of the certification reports conclusions have been drawn on the necessity of additional guidelines. A Guidelines document has been drafted for aspects, which appeared to be not clear enough. This is described in the next chapter.

### 4. RESULTS OF EWTC: GUIDELINES FOR DESIGN EVALUATION OF WIND TURBINES

#### *Scope of the Guidelines*

The result of EWTC is a set of guidelines for uniform certification. The purpose of the Guidelines document is to provide guidance in design evaluation where the existing standards used in wind turbine certification are insufficiently clear. The guidance is given in such a way that design evaluation by different Certifying Bodies in Europe does not lead to different results and that their design evaluation reports are mutually acceptable.

The recommendations are based upon the findings from the three case studies. The document reflects the common opinion of the EWTC partners on specific issues encountered during this exercise. It of course also reflects the present level of understanding within and between Certifying Bodies in Europe.

These Guidelines are complementary to the requirements in IEC 61400-1 and IEC WT 01 and in principle only include explicitly those points not sufficiently covered in the above mentioned standards. The Guidelines shall be used in combination with the latter documents. The objective is that the use of this set of documents will ensure uniform practice in wind turbine certification.

The scope of the Guidelines includes all items investigated in the process of wind turbine type certification as defined in IEC WT 01.

The EWTC project team specifically focused on the following items of wind turbine type certification, and hence formulated specific additional harmonising guidelines on these items:

- Control and Protection Systems;
- Load Cases and Loads;
- Components and Electrical System;
- Other Items of Design Evaluation;
- Reporting Format for Evaluation Reports;
- Inspection and Function Testing.

The team considered the remaining items of IEC WT 01 formulated as sufficiently clear and did not formulate additional guidelines for these items. The full text of the Guidelines is given in the final report of the project [5].



**Figure 2.** The JI48 wind turbine of Jeumont Industrie was subject to Case Study 2 of EWTC. The machine showed in this picture was function tested 1 April 2001 at Widehem in the North of France.

#### *Some highlights in the Guidelines*

The document contains specific statements on many aspects of IEC WT 01. To illustrate this, some of the highlights of the document are summarised briefly here:

- The document gives more detailed specification on the documentation and descriptions needed to demonstrate the adequacy of the control and protection system, for example on the hydraulic and electrical auxiliary systems, braking systems etc. It is expected that this guidance will ensure better documentation by the manufacturer and more clarity on what has been evaluated by the CB.
- The document gives guidance on what has to be reported about independent load calculations.
- The document contains specific requirements and clarifications about some of the IEC 61400-1 load cases, which have been recently been debated, e.g. the load cases DLC 6.1 and 6.2. The Guidelines showed in this case to be a document in which more recent agreements between CB's can be incorporated, without having to wait for the approval of formal standards.
- The Guidelines contain detailed specification of items to investigate and report in the wind turbines inspection and function test.

#### *Expected significance of the Guidelines*

The participating certifying bodies can include the Guidelines in their internal schemes. Thus, harmonisation is achieved. However, it is not realistic to assume that the Certifying Bodies will formulate, update and apply these Guidelines on a voluntary basis without external "enforcing" or supporting mechanisms.

Therefore external formal circuits have to play a role in the implementation of the Guidelines. The Certifying Bodies should maintain the proper amount of control on the contents which will not always be easy because e.g. the Guidelines will necessitate additional effort (mainly information supply) from the manufacturers. The project

team decided to inform the following bodies about the Guidelines:

- The national standards committees in Europe (at least DK, NL, D);
- The certification board of IEC;
- The technical committee IEC TC88.



**Figure 3.** The Nordic 1000 of Nordic Wind Power wind turbine was subject to the evaluation in Case study 3 of EWTC. The wind turbine shown in the picture was tested in Gotland by the EWTC team in March 2001.

## 5. TO WHAT EXTENT HAVE THE OBJECTIVES BEEN ACHIEVED?

This chapter contains the evaluation on how much the project succeeded in reaching the objectives set out in the original work plan. These conclusions are given with respect to both the detailed and the general project objectives.

#### *Common procedures*

Based upon the conclusions and results of the project, the EWTC project team recommends for uniform certification in Europe to basically follow the method of work that has been defined in the project. Wind turbine type certification is based on the two IEC documents (IEC 61400-1 and IEC WT 01), complemented by a Guidelines document. The team recommends to keep this document updated on a regular basis. The team realises that the updating now is on a voluntary basis and that there need to be a structured way to make updating of the Guidelines happen on a regular basis. The team recognises the need to seek the viewpoints of IEC TC88 on the contents of the Guidelines.

#### *Country specific guidelines*

The EWTC project team has formulated Guidelines to be followed to ensure uniform interpretation of a common certification standard. The Guidelines can be applied in every country of the EU. It is therefore not necessary to prepare specific Guidelines per country. From the comparison of the practices there was no evidence of a need for such specific guidelines. The project team concluded that the use of the IEC documents together with the Guidelines allows for design evaluation of wind turbines in the European

countries in a mutually acceptable way.

#### *Formal procedures for implementation*

The EWTC project team recommends a two step approach to establish formal procedures for implementation of the Guidelines:

- the Guidelines should be implemented in the accreditation systems of the certifying bodies in Europe;
- Consent about the Guidelines should be reached from the national committees and IEC TC88.

For both of the steps a mechanism should be in place to enforce the certifying bodies to keep working jointly on the common objective. Such mechanism could be a follow up of this European project.

## 6. CONCLUSIONS IN VIEW OF THE MAIN OBJECTIVE OF EWTC

The main objective is to come to uniform harmonised wind turbine certification, adjusted to the needs of the wind energy industry and the requirements of the European legislation. Although some progress has been made by working together on common certification projects, more efforts are needed before this objective can be fully reached. In the original stage of the EWTC project it was thought that the main problem preventing uniform certification was situated in the interpretation differences of the IEC documents. The EWTC project also was primarily geared to tackle this problem. One striking example of agreement is the clarification in the Guidelines of the DLC 6.1 in IEC 61400-1. Besides drafting Guidelines for common interpretation, the EWTC team has been able to pinpoint where difficulties are when preparing a joint certification report and found practical ways out in terms of: which additional input is needed in order to obtain a complete design documentation from the manufacturers, how to write certification reports that are mutually acceptable. In this respect, substantial progress has been made. The team has taken good notice from the manufacturers' signal that the uniform certification should be practical for the "real life", meaning that the harmonised certification should not be the sum of all national requirements.

It is expected that in the near future continued harmonisation efforts by the certifying bodies will lead to:

- less problems in due diligence assessments for operators and financiers;
- input for relevant IEC projects (IEC WT 01 ed.3, IEC WG3 Offshore) and EU projects (RECOFF).

With respect to this last point it can be concluded that the EWTC project has already been contributing to a European wind turbine certification standard. The partners are actively involved in the above mentioned activities. There has been a direct link with the EWTC project in this respect. Moreover, these activities offer a scope for the continuity in harmonisation of certification.

Besides it should be remarked that in order to realise a change of the present scenery of diversity in certification, national legislation changes are needed.

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