pavan

A News Bulletin from CENTRE FOR WIND ENERGY TECHNOLOGY, Chennai

C-WET
An ISO : 9001 - 2000 Organisation

www.cwet.tn.nic.in

ISSUE - 17
April - June 2008

EDITORIAL

In spite of global recession and amidst declining cost of fossil fuels Indian Wind Energy Programme is still marching ahead, with a total installed capacity of over 8,684 MW in 2008. The capacity addition in the Q1 of 2008 is around 10.5%. While the technical capability of wind turbine technology in India is steadily on the rise, with manufacturing of blade, towers, generators and gear boxes happening in India, it's the earlier installation of Class-I (good windy) sites with lower capacity machines, need to be relooked into. This essentially demands a re-thinking in the lines of re-powering the best windy sites. Several fiscal and other incentives including preferential tariffs by State Electricity Boards are continued to foster the growth of the sector. The Government and Wind Turbine Manufacturers should strengthen the indigenous Research & Development and establishment of manufacturing facilities to cater to the country specific needs.

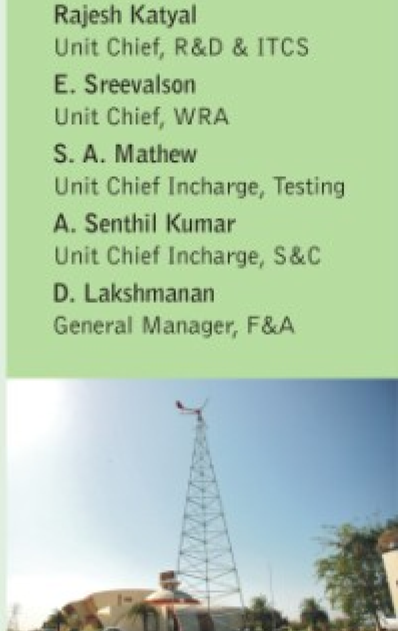
Centre for Wind Energy Technology, with its commitment as an enabling body for Wind Energy Development in India, strives to harness even the available wind power in India through small size wind machines popularly known as aerogenerators. The Research and Development (R & D) unit has already started operating small wind turbines for demonstrating the feasibility with a wind-solar and wind-solar diesel hybrid as a practical stand-alone utility. Two commercial aerogenerators are already under performance testing at C-WET's Wind Turbine Test Station (WTTS), Kayathar. Testing unit continues its instrumentation and performance testing at WTTS, Kayathar as well as client's sites which qualify IEC condition of terrain for testing. With a great demand for manpower for type certification, C-WET's Standards and Certification (S&C) unit continues its review of documentation under the TAPS-2000 scheme, for several new entrants in Wind Energy in India. The Wind Resource Assessment (WRA) unit staff of C-WET are flooded with variety of projects, from industries, including third party data validation, micro-siting, project feasibility and proposals for remote Island / Offshore wind data collection and consultancies for setting up wind farms by several Government as well as public sector industries.

C-WET would heartily welcome the industry, stakeholders of Wind Energy and general public to share their valuable comments on issues of wind energy development in India and also for further promote the effective use of our newsletter Pavan.

K.P. Sukumaran
Executive Director

Contents

Editorial Board



Developments in R&D UNIT

Database on Wind Power Generation

The need for establishment of a database on wind turbine performance has been expressed in various forums. Presently, activities related to wind power generation are spread across seven states viz., Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, Rajasthan, West Bengal and Gujarat. The generation related data by State Electricity Boards are mostly in the paper form and reporting form also varies from area to area. In order to address the above issue, R&D unit in consultation with M/s Telecommunication India Limited (TCIL) is in the process of establishing an efficient and reliable data collection system from the performance of the wind turbines in the state of Tamil Nadu, initially.

For this purpose, a web-based software solution on latest web framework will be developed related to the collection of generation data and dissemination of information from these data in the most efficient manner.

Testing of Small Wind Turbine

The unit has undertaken testing of 1 kW stand-alone Small Battery Charger manufactured by M/s UD Energy Private Limited at Wind Turbine Test Station, Kayathar. The test measurements to be performed will be power performance measurement, duration test and safety function test. With this, the Centre will complete testing of two small wind turbines in the ensuing windy season.

Move on in WRA UNIT

Under the National Wind Monitoring Programme, 24 new stations in nine states have been installed during this period. Presently, seventy wind monitoring stations are operational under various wind monitoring projects like Wind Resource Assessment in uncovered / new areas, Wind Resource Assessment in North East Region and Consultancy projects etc.

Verification of Procedure of Wind Monitoring at Manavale in Kolhapur district, Maharashtra has been taken up for M/s. Sanchay Properties Private Limited, Mumbai.

A project on "Power Curve Demonstration" for 17.6 MW wind farm projects at Pushpathur, Tamil Nadu has been taken up for M/s. Chennai Petroleum Corporation Limited, Chennai.

Micrositing and Annual Generation Estimation for 120 MW wind farm at Bagalkot district, Karnataka has been taken up for M/s. NSL Power Limited, Hyderabad.

Consultancy services for the proposed 10 MW wind farming project has been started up for M/s. Indian Railways, Integral Coach Factory (ICF), Chennai.

Energy estimation at Wind Mast of location of DS Halli & Kyadigere sites in Karnataka has been carried out for M/s. Bhoruka Power Corporation Limited, Bangalore.

Due diligence for the 35 MW wind farm projects in Maharashtra has been completed for M/s. Tata Power Company Limited, Mumbai.

Site Validation & Generation Estimate for their proposed wind farms has been initiated for M/s. RS India Wind Energy Private Limited, New Delhi.

Completed Projects

The unit has completed five Verification of Procedure of Wind Monitoring at

- Andhra Lake, Pune district in Maharashtra for M/s. Enercon (India) Limited, Mumbai.
- Jakhau, Kutchh district in Gujarat for M/s. Suzlon Energy Limited, Pune.
- Soda Bandhan, Jaisalmer district in Rajasthan for M/s. Suzlon Energy Limited, Pune.
- Phalodi, Jodhpur district in Rajasthan for M/s. Suzlon Energy Limited, Pune.
- Khanapur, Satara district in Maharashtra for M/s. Enercon (India) Limited, Mumbai

WRA unit has also completed the following projects and submitted reports during this period :

- Technical Evaluation of Micrositing of the proposed wind farm project in Rajasthan for M/s. Bharat Petroleum Corporation Limited, Noida.
- Technical Evaluation of the proposed 50 MW wind farm in Tamil Nadu for M/s. Salem Steel Plant (SAIL), Salem, Tamil Nadu.
- Micrositing for Wind Farm Projects at TB Dam Hills, Hospet in Karnataka for M/s. MSPL Limited, Hospet, Karnataka.

Steps forward in TESTING UNIT

The measurements for RRB-600 kW wind turbine of M/s.RRB Energy Ltd. at Valayapalayam, Tamil Nadu has been completed and the reporting is ongoing.

The re-instrumentation of Siva-250 kW wind turbine at WTTS, Kayathar and IWPL-250 kW wind turbine at Navadra, Gujarat have been carried out and the measurements are ongoing.

Blade Instrumentation for M/s. Shriram EPC's LEIT WIND Model LTW77 1.35 MW completed successfully at Oothumalai, Tamil Nadu.

The Instrumentation of Chettinadu 600 kW wind turbine of M/s. Chettinadu Energy Limited at Thirumangalakurichi, Tamil Nadu is ongoing.

The unit has carried out analysis of the test data received from MEASNET as the part of evaluation for membership and the report has been sent for review. The results are awaited.

Marching ahead in S&C UNIT

The renewed Provisional Type Certificate (PTC) has been issued to M/s. Southern Wind Farms Limited for GWL 225 – 225 kW wind turbine model upon successful completion of review of documentation for renewal.

Agreement has been signed with M/s. RRB Energy Limited (formerly M/s. Vestas RRB India Limited) for renewal of PTC of V39 – 500 kW with 47 m rotor wind turbine model as per TAPS – 2000 (Amended). Renewed PTC has been issued upon successful completion of review of documentation for renewal.

Agreement has been signed with M/s. RRB Energy Limited for review of documentation for closure of outstanding issues pertaining to the Provisional Type Certificate of Pawan Shakthi – 600 kW wind turbine model.

The certification projects, taken up as per TAPS – 2000 (Amended), are under progress.

The continual improvement and maintaining the Quality Management System (QMS) are ongoing.

NEWS

India Offers Wind Power Incentives

The Ministry of New and Renewable Energy (MNRE) announced an "Incentive" of Re.0.50 per unit of wind-power fed by the independent power producers into the grid. The generation based incentive (GBI) is aimed at increasing the quantum of grid interactive renewable power.

"The investors, apart from getting the tariff as determined by the State Regulatory Commissions would get an inventive of Re. 0.50 per unit of electricity for a period of ten years provided they do not claim the benefit of accelerated depreciation" said Vilas Muttemwar, Minister of State for New and Renewable Energy. The Ministry had earlier announced the provision of 80 percent accelerated depreciation under the income tax act for those investors who have a sound balance sheet to absorb the depreciation benefits.

The Minister also added that the incentive will be provided to the eligible project promoters through Indian Renewable Energy Development Agency (IREDA) – a Government company under the MNRE which promotes and extend financial assistance for renewable energy projects. The IREDA will give the GBI to the generators through their bank accounts on a half yearly basis through e-payment.

The inventive, however, will be limited only for those grid interactive wind power generation plants which have a minimum installed capacity of 5 MW and installed at project sites approved by the Centre for Wind Energy Technology (C-WET). Earlier this year, the Ministry has announced a similar demonstration scheme to provide generation based incentive to grid interactive solar power projects of upto a maximum capacity of 50 MW.

The installed capacity of power from renewable energy sources stands at about 12,400 MW currently out of which about 10,250 MW is connected to the grid. The government now plans to ramp up the capacity from renewable sources to 15,000 MW by end of the current plan period (2007 -2012). A major chunk of this renewable power capacity – 10,500 MW – is to come from wind energy.

Source: http://www.windenergynews.com

Where to store wind-powered energy? Under water!

Since it became a viable energy resource around 20 years ago, wind power has emerged as a leading renewable technology.

At the end of 2006, the worldwide capacity of all wind turbines was close to 75 gigawatts, which represents around one percent of all electricity use in the world.

Three quarters of that wind power usage is currently based in Europe. The Danes lead the way with nearly 20 percent of their electricity created by wind. They are followed by Germany, which generates around half that amount and Spain around seven percent.

But although it's clean, plentiful and relatively cheap, there is an inherent problem with wind power. It's not always there when you need it, leaving more conventional, more polluting energy resources to take up the slack.

The wind's variability has been one of the sticking points for wind power growth in the UK energy market. Given the UK's famously inclement weather and its island status -- which offers unrivalled offshore facility - you might think that wind power capacity was being filled at a rate of knots.

But in reality, wind power currently contributes about one percent of the UK's energy needs, with around 2000 on and offshore turbines up and running.

Whilst wind is no silver bullet to the energy problem, it can make an important contribution to the equation. This is especially true in the UK, which possesses 40 percent of Europe's total wind energy.

The prospects for wind power could be greatly enhanced if cost-effective storage could be implemented. Some, like Minnesota based Xcel Energy, are putting their faith in new battery technology. But a UK professor, Seamus Garvey thinks he might have found another solution -- storing energy in flexible containers on the ocean floor.

Professor Garvey's idea of using Compressed Air Energy Storage (CAES) isn't a new one, but his methods are :

Traditionally, CAES stows energy in a vast underground reservoir. During peak energy hours, air is released powering a turbine, which in turn produces electricity. There are currently only two CAES sites in the world -- in Huntorf, Germany and in McIntosh, Alabama.

Based at Nottingham University, Professor Garvey -- whose interest in wind turbines stretches back to his school days -- began his research into compressed air storage two years ago.

"I was thinking about how textile composites and textile structures might be relevant in the context of renewable energy," he told CNN.

In a moment of inspiration, Garvey realized that air could be compressed using a wind turbine or a wave-powered device.

"Drawing a mass down within the blade of the piston itself compresses the air," he said.

The prospects for his energy storage idea with tidal power are perhaps even better. "With tidal power you can use a hydraulic ram. This can take a large flow of water at a low pressure. Out of that it can then give you a small flow of water at a high pressure."

Naturally, storing vast amounts of air requires vast amounts of storage. Professor Garvey envisages a cone-like structure stretching 50 metres wide at the top to around 80 metres across at the base.

The bags are made of a combination of plastics. "A polyester reinforcement at the core with probably a polythene layer around that," Garvey said.

At a depth of around 600 metres, Professor Garvey calculates that the bags would be able to store 25 megajoules of energy for every meter cubed. The deep water is essential. "Only in deep water, where the pressure is greatest, are the bags a good economic proposition," Garvey explained.

Although there is an additional cost in fixing reinforcement cables and ballast, Garvey believes the future economic prospects for his invention are good.

He plans to put the storage bags through smaller scale land-based tests, with four-metre-diameter bags, to prove that his calculations are right.

The centrifugal force required to compress the air is too great for small wind turbines to cope with, so much larger turbines will have to be installed for the project to realize its goals.

Currently, wind turbines are situated in relatively shallow water - around 40 metres. So, how will the project work if the bags need to be at a depth of 600 metres?

Well, a series of pipes will link turbine and bag and Professor Garvey believes the distances, in Europe at least, wouldn't have to be too long.

Research into floating turbines is underway and, as Professor Garvey points out there are steep ocean shelves off the west coast of France and Portugal and around the entire periphery of the Mediterranean. "You could put wind turbines on these shelves and within a few hundred metres, or kilometres you could be in 600-metre-deep water," he said.

Professor Garvey, who has secured a three year grant from German energy provider E.ON, is confident that with the right funding the UK can achieve its stated aim of providing 20 percent of its energy from renewables by 2020.

"We're probably the richest country per head in the world in terms of renewable energy," he said. "But we're way behind Denmark, Germany and the United States."

He thinks that the realistic prospect for the future is a combination of nuclear and renewable energy as the best way to reduce carbon emissions quickly.

The argument against wind power being intermittent and therefore unreliable may dissolve as Professor Garvey continues his research. Plastic bags in our oceans might prove to be a cause for celebration and make wind power a much more attractive economic proposition than it is today.

Source: http://edition.cnn.com/2008/TECH/science/ 03/31/ windpower

A New Tool for Sodar-Based Wind Assessment Now Commercial

The first TritonTM sonic wind profiler - a new tool for sodar-based wind assessment - is being shipped today, and more than 15 additional units will ship to customers over the next two months.

All of the beta customers who participated in Second Wind's rigorous product testing program are also expected to keep the units they have purchased, Second Wind said today in announcing commercial availability of the product.

First announced at WINDPOWER 2007 last June, the Triton device was designed to address common challenges that have limited the use of sodar for wind resource assessment. It captures accurate wind data upto 200 metres, in any weather, at any location, without being attended. Readings look like anemometry results, with no expert analysis required.

Customers can access their Triton data in real time from any computer over the SkyServeSM satellite wind data service – available both for Triton and Second Wind data loggers. Every 10 minutes, SkyServe transmits data from the Triton over the Globalstar satellite network. It combines weather data with precise time and location stamps, using Global Positioning System (GPS) technology.

"Seeing Really Good Data" Triton has undergone a multi-site beta program in a variety of locations across the country including California, Massachusetts, Oregon, Texas, Vermont and Washington. Each location allowed the Triton development team to study the device in different locations and under a variety of weather extremes – allowing them to verify and refine key features of the device.

The beta test demonstrated that the Triton performs better than previous sodar products–self-powered, portable and able to survive rough weather. Second Wind CEO Walter Sass said that customers can feel very confident about Triton data, which correlates strongly with anemometer readings in side-by-side comparisons. Customers can expect usable data readings at heights approaching 200 metres, with very strong results between 50 and 140 metres – which covers the blade sweep of most commercial wind turbines.

Second Wind provided its customers ongoing progress reports on beta tests through an electronic newsletter. The newsletters included details about product features, a variety of data graphs, feature enhancements as they were developed and other details. Each newsletter issue can be found on <http://www.secondwind.com> www.secondwind.com.

Paul F. Wendelgass of Competitive Power Ventures, Inc. is a beta customer of Second Wind and said the Triton has been functioning extremely well and reliably reporting the data.

"As a developer, I look at a site and it's important to know the average wind speeds over a period of time and SkyServe provides that data on screen. I have the Triton placed next to a meteorological mast at a site in Kansas and am seeing really good data correlation between the two," Wendelgass said. "I really like the SkyServe product – I am able to go online, download data and plot out graphs in real time to look at the data and see how my site is doing. Ultimately, I'd love to get to a point where I can just install Tritons at my sites, rather than putting up met masts – and I'm very hopeful." Continuous Product Improvement Sass said that Second Wind used its beta program to make sure the unit met its exacting quality standards before announcing commercial availability.

Enhancements made during the beta test program included a second solar panel and electrical system improvements to ensure self-powered operation as well as retrofitting units with a noise dampening insulation.

"While we'll continue working with beta customers to analyze data and continuously improve the product, commercial availability is an important milestone that reflects the successful development of an exciting new tool for wind assessment," Sass said.

Second Wind opened its own Triton manufacturing operation in Somerville, MA and is preparing to fill orders with a lead time of one to three weeks. Packages, including power and satellite communications, start at $40,000. For more information, visit www.secondwind.com.

Source: http://www.renewableenergyworld.com

Testing of Small Wind Turbines

Rajesh Katyal, Unit Chief, R&D/ITCS and
Deepa Kurup, Scientist, R&D, C-WET

1. Introduction

Small Wind Turbines / Aerogenerators are used as stand-alone battery-charging systems or as hybrid in conjunction with solar photovoltaic systems or diesel / biofuel run generators to power small loads such as lighting, water pumping and household appliances.

They can be used in remote places not connected to the grid to meet the basic power requirements or can also be employed in localities with weak grids and high winds.

The standard IEC 61400-2 refers to small wind turbines / aerogenerators with swept area less than 200 m^2 (i.e. rotor diameter less than or equal to 16 m) and generating at a voltage below 1000V a.c. or 1500 V d.c.

2. Importance of testing

Testing of a wind turbine enables us to verify its engineering integrity and safety philosophy. The tests on aerogenerators are designed to ensure that the performance and operation of the wind turbines are as predicted in the design. Recent years has seen enormous increase in the number of players in this particular field. Hence the need was felt to establish testing facilities for small aerogenerators so as to streamline the manufacturers based on the performance of their machine.

3. Small Wind Turbine (SWT) Classes

Small wind turbine/aerogenerator classes are defined in terms of wind speed and turbulent parameters as shown in table-1 (reproduced from IEC 61400-2) below:

SWT Class		I	II	III	IV	S
V_{ref}	(m/s)	50	42.5	37.5	37.5	Values to be specified by the designer
V_{ave}	(m/s)	10	8.5	7.5	6	
I_{15}	(-)	0.18	0.18	0.18	0.18	
α	(-)	2	2	2	2	

Where

- the values apply at hub height, and
- I_{15} is the dimensionless characteristic values of the turbulence intensity at 15 m/s
- α is the dimensionless slope parameter.

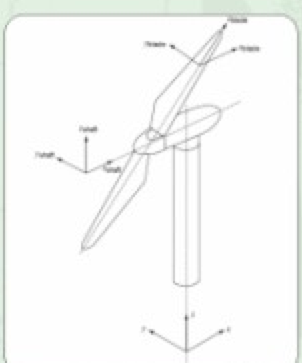


Figure-1 System of axes for HAWT (IEC 61400-2)

4. Classification of tests on Small Wind Turbine

The IEC 61400-2 classifies the following tests on small wind turbines :

1. Tests to verify design data
2. Mechanical load testing
3. Duration testing
4. Mechanical component testing
5. Safety and function tests
6. Environmental testing
7. Tests on electrical sub-systems

4.1. Tests to verify design data

The tests which can be performed in-house by the manufacturer verify design power, design rotational speed & design shaft torque at design wind speed, maximum rotational speed and maximum yaw rate.

4.2. Mechanical load testing

Tests include loads at critical load path locations in the structure, meteorological parameters and wind turbine operational data (rotor speed, electrical power, yaw position, turbine status). The loads may include blade root bending moments, shaft loads and loads acting on the support structure. The tests shall be performed as per IEC 61400-13.

4.3. Duration testing

The purpose of the test is to investigate

- Structural integrity and material degradation (corrosion, cracks, deformations).
- Quality of environmental protection of the wind turbine.
- Dynamic behaviour of the wind turbine.

4.4. Mechanical component testing

This includes tests carried on the load carrying components (where no calculations have been performed) such as blade, hub, nacelle frame, yaw mechanism and gearbox and can be performed in-house by the manufacturer.

4.5. Safety and function tests

The purpose of safety and function testing is to verify that the turbine under test displays the behavior predicted in the design and that provisions relating to personnel safety are properly implemented.

4.6. Environmental testing

If the turbine is designed for external conditions outside the normal external conditions, the turbine shall be subjected to tests simulating those conditions.

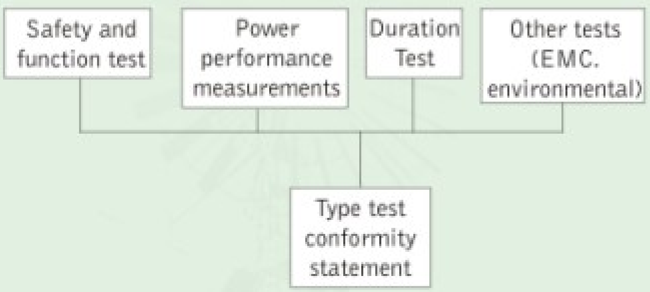
4.7 Tests on electrical sub-systems

Tests shall be carried on all safety critical electrical sub-systems of the turbine in compliance with the relevant IEC and National Standards.

Out of these seven available tests for small wind turbines, safety & function tests, power performance measurements, duration tests and other tests (environmental tests) constitute type testing of small aerogenertors. Duration test and safety and function tests are mandatory tests for small wind turbines. Power performance is an important type characteristic of small wind turbines. Hence, three type tests have been identified by R&D unit of C-WET in its testing programme.

5. Description of Type Tests

The four elements of type testing of a small wind turbine are as shown below:



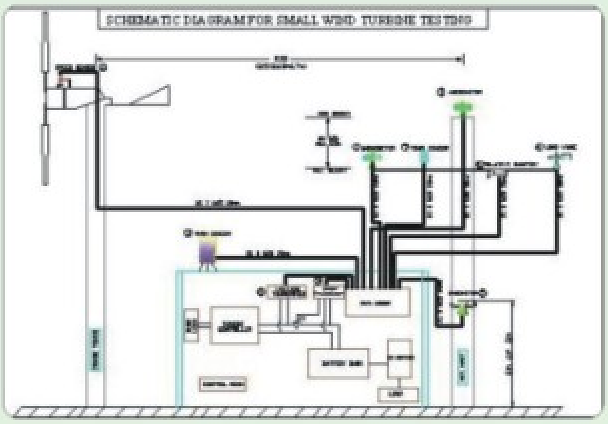
The present testing program focuses on the following tests of the Small Wind Turbines :

1. Power Performance Measurement
2. Duration Test
3. Safety and Function Test

5.1 Power Performance Test

The Power Performance Test will be carried out in accordance to the IEC standard, Wind Turbine Generator Systems, Part 12: Power Performance Measurement Techniques, IEC 61400-12-1. Small wind turbines can be used as battery charging device, grid connected systems or can directly run electrical loads like motor or resistive load. For a battery charging turbine, the power performance measurement test must take into account the affect of battery state of charge (i.e. voltage variations in the load) on power output.

The WTGS power performance characteristics are determined by the measured power curve and the estimated Annual Energy Production (AEP). The measured power curve is determined by collecting simultaneous measurements of wind speed and power output for a period that is long enough to establish a statistically significant database over a range of wind speeds and under varying wind conditions. The AEP is calculated by applying the measured power curve to reference wind speed frequency distributions, assuming 100% availability.



As per IEC 61400–12-1, the anemometer must be located between 2 and 4 times the rotor diameter from the turbine. Another anemometer will be located at 1.5 m below the primary anemometer as a check on the primary anemometer.

5.2 Duration Test

The load measurement and blade fatigue tests of large wind turbines are replaced with the duration test. As per IEC 61400-2, duration test requires that the turbine has reliable operation during test period, at least 6 months of operation, at least 2500 hrs of power production in winds of any velocity, at least 250 hrs. of power production in winds of 1.2 V_{ave} & above and at least 25 hrs. of power production in winds of 1.8 V_{ave} and above, where V_{ave} is the annual average wind speed at hub height. The V_{ave} value is determined by the SWT class under which the turbine falls. Reliable operation means operational time fraction of at least 90%, no major failure of the turbine or components in the turbine system, no significant wear, corrosion or damage to turbine components and no significant degradation of produced power at comparable wind speeds.

Measurements that will be taken during the duration test are power production, turbine operational time fraction, and wind speed consisting of 10-minute average, turbulence intensity and wind direction. Power is measured by a power transducer at the connection to the electrical load. Turbine operational time fraction is determined from the test log //4//.

To check any hidden degradation in power performance, the power levels shall be binned by wind speed every month. The binned power levels shall be plotted as a function of time for each wind speed and any visible trends shall be investigated.

At the completion of the duration test, a detailed component wear and durability check for the entire turbine will be conducted. It will include an assessment of the structural integrity and material degradation (corrosion, cracks and deformations).

5.3 Safety and Function Test

The purpose of the safety and function test is to ensure a fail-safe operation of the turbine under all conditions. It is conducted in accordance with provisions listed in IEC 61400-2. Unlike large wind turbines, the control and protection systems for small turbines are very simple and often passive.

The safety and function test consists of the following:

Emergency shutdown operation: Brakes will be applied to check if the turbine shuts down at normal and high wind speeds.

Power and speed control: This is to ensure that the power and speed of the turbine remain within design limits. The power output and the rotor speed of the turbine will be measured. The maximum rotor speed shall be determined by interpolation or extrapolation to V ref, corresponding to the SWT class.

Yaw control: This shall be verified by visual inspection.

Loss of load: The condition shall be simulated by an open circuit at the turbine terminals and the braking mechanism of the turbine shall be verified.

Over-speed protection: This verifies how the over-speed protection mechanism of the turbine works under fault conditions or above design wind speeds.

Start-up and shutdown above the rated wind speed: The start up and shutdown mechanism above rated wind speed for the turbine are monitored.

In addition to the above mentioned critical functions, the following may also be verified if applicable :

Excessive vibration protection: The test verifies the vibration protection mechanism of the turbine.

Battery over-and under-voltage protection: The test verifies the over- and under-voltage protection mechanism of the turbine at battery voltages outside set points, for battery charging systems. The battery voltage, dump load status and load status are monitored and correlated.

Cable twist: This is to verify the turbine cable untwist yawing mechanism.

Anti- islanding (for grid connections): This verifies that any electrical system (capacitors) that by itself can self excite the SWT shall be automatically disconnected from the network and remain safely disconnected in the event of loss of network power.

6. Selection of Test Site

The basic requirements for selection of test sites will depend on the terrain conditions and minimum wind speed requirements. Presently, the tests on SWT are being carried out at WTTS, Kayathar.

Wind speed statistics for Kayathar are as follows:

Maximum average wind speed	:	5-6 m/s
Peak wind speed	:	20 m/s

The guidelines for the selection of site for carrying out tests on SWT as per standard IEC 61400-12 -1 are followed.

7. Conclusion / Recommendations

Aerogenerator / Small Wind Turbine testing will be the first of its kind to be carried out by C-WET. The present testing programme would form the basis for improvements in testing procedure in future. The power performance measurement, duration test and Safety & function test will be carried out during the present testing programme. C-WET will continue to develop small wind turbine testing capabilities.

References

1. IEC WT01 IEC System for Conformity Testing and Certification of Wind Turbines : Rules and procedures
2. IEC 61400-12-1 Wind Turbine Generator Systems, Part 12: Power Performance Measurement Technique
3. IEC 61400-2, Wind Turbines, Part 2: Design requirements for small wind turbines
4. Certification testing for small wind turbines, NREL & Southwest Windpower

Published by :
CENTRE FOR WIND ENERGY TECHNOLOGY (C-WET)
An autonomous R&D institution established by the Ministry of New and Renewable Energy (MNRE), Government of India
To serve as a technical focal point of excellence to foster the development of wind energy in the country
Velachery - Tambaram Main Road, Pallikaranai, Chennai - 600 100
Phone : +91-44-2246 3982, 2246 3983, 2246 3984 Fax : +91-44-2246 3980
E-mail : info@cwet.res.in Web : www.cwet.tn.nic.in