C-WET

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A news bulletin from the Centre for Wind Energy Technology, Chennai

editorial . . .

The financial year 2005-06 ended with a bang for wind industry in India. A thrill similar to the one experienced some time back when SENSEX breached 5000 mark, when dooms day pundits had predicted a disaster. Now sensex has crossed 11000 and still going strong. Such bull-run has brought up brilliant winners from an unexpected field of wind energy. When state-wise figures were added on the 31st March the installations crossed 5400 MW. It really is a time to congratulate each other on this third successful run. It also is a time for considerable introspection by all of us. The field has made visible successes and incredulity will wear off and increased competition from other conventional sources is to be anticipated. Though we keep saying that there is enough elbow room for all of us in the market and we are not competing but complementing each other in a generally demand driven energy market, the field has enough exciting challenges from within and outside to face.

With many of the well known sites becoming saturated with wind turbines, there is an urgent need to have a rationale as to where do we go from here. On one hand, the idea that larger unit sizes of wind turbines will increase the potential seems, on the face of it, a plausible way of increasing potential. This has two serious implications. First one is that the locations have lower capacity machines installed just a few years back and in most cases would not have paid back the investment, let alone profits. The other aspect is what to do with the machines after dismantling. This sort of a decision can only be taken only if the numbers of such installations are smaller.

Another issue that needs attention is the conversion efficiency of wind turbines. This is again not a simple or straightforward computation. Today we have wind turbines of all sizes with different hub heights, rotor diameters and several technologies. There is of course the cost per kWH delivered which will somehow bring all of them to a common platform. This will, unfortunately, distort the real need to maximize energy output per acre of land utilized. Wind turbines, which may have poor efficiencies may be available at much lower cost thereby getting higher returns for a given investment. The client cannot be questioned for not having gone in for the latest technology. For him, it is one of the factors he has to consider before making a choice.

Important aspect that needs attention will be to keep the promises made with regard to generation guarantees, major emphasis on customer delight on O & M aspects. As with any service oriented field, a certain amount of client disillusion is to be anticipated and addressed effectively. Considerable introspection is required here and conscious efforts would have to be made to address the issues in a rational manner. It should not be shrugged off saying 'not in my backyard, we give best of services'. In a growing market customer discontent may show its influence over a period of time. There fore this aspect should form one of the fundamental aspects company ethics. With major investments being made into the sector, this aspect is already being addressed effectively.

M.P.Ramesh, *Executive Director*

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Centre for Wind Energy Technology has been awarded the "*SESI Special Award to Centre of Excellence*" by the Solar Energy Society of India. *Shri. Vilas Muttemwar, Honorable Minister of State, (Independent Charge) has handed over the award to Shri.* M. P. Ramesh, Executive Director, C-WET *on the occasion of* inaugural ceremony of ICORE-2006 on 08th February 2006 held in the Hyderabad International Convention Centre, Hyderabad.

Mr. V. Subramanian has assumed the charge of Secretary, Ministry of Non conventional Energy Sources, Government of India. Mr. Subramanian is a senior IAS officer of West Bengal cadre. He is the Chairman of the Governing Council of the Centre for Wind Energy Technology

EVENTS, MEETINGS, SEMINARS, CONFERENCES AND TRAINING

WIND POWER 2006

Conference & Exhibition

June 4-7, 2006

Pittsburgh, PA

5th WORLD WIND ENERGY

Conference-Cum-Exhibition 2006

The Ashoka, New Delhi
6-8 November 2006

Record year for Wind Energy: Global wind power market increased by 40.5% in 2005

Continued political efforts can give even stronger impetus for 2006

The global wind energy sector experienced another record year in 2005. According to the figures released today by the Global Wind Energy Council (GWEC), the year saw the installation of 11,531 megawatts (MW), which represents a 40.5% increase in annual additions to the global market, up from 8,207 MW in the previous year. The total value of new generating equipment installed was over •12 billion, or US$14 billion.

The total installed wind power capacity now stands at 59,084 MW worldwide, an increase of 24% compared to 2004

Installed Capacity of Indian Wind Power

According to preliminary information received from various sources, installed capacity of wind power in India is likely to cross 5400 MW by 31.03.2006. This means a capacity addition of more than 1600 MW during the financial year 2005-06.

Work at C-WET

DEVELOPMENT IN R&D UNIT

R&D Demonstration Wind Farm

R&D unit is presently working to set up a 2 MW wind farm as a prerequisite for development of research capabilities. Serious R&D, if carried out with private developers, will mean their machines has to be stopped, modified, subject to testing and measurements causing loss of generation and risking their investments in the long run. Hence, a need was felt to develop a R&D Wind farm to carry-out various researches in the field of wind energy sector in India.

The "Field laboratory" would be an R&D demonstration wind farm consisting of different sizes of latest and new technology wind turbines, fully equipped with complete measurement systems and diagnostic tools. This will also facilitate and act as a training centre for other technical, academic institutions.

Parameterisation of flow distortion around wind turbine nacelle

This project aims at studying the dynamics of wind flow around the nacelle body and to determine the position of free stream wind near the nacelle body through a wind tunnel experiment. This would provide the basis for positioning the anemometer on the top of the nacelle for site calibration experiments in the future for power performance testing. This will also assist in correcting the measured power curve for site effects with in complex terrains. For the purpose, a fabricated scaled model of the wind turbine was placed in a wind tunnel and simultaneous velocity measurements was made for 120 points in one plane and 15 such planes were considered. The planes were arranged with 9 behind the nacelle, 3 along the nacelle and 3 in front of rotor. The simultaneous measurements were carried at three different wind speeds of 6 m/s, 8 m/s, and 10 m/s using two sets of 64 numbers of pressure transducer and acquiring the data through PC based data acquisition system. These measurements will be compared with measured field data for necessary validation.

A view of Wind Tunnel experiment

Dissemination of R&D Activities

Shri S. Suresh Babu of R&D Unit was invited to deliver a detailed presentation on "Power Evacuation Challenges and modeling needs" by Indian Wind Power Association at Coimbatore on 15.03.06. The presentation covered following aspects:-

- Challenges and complexity of the fundamental technical issues in the power system modeling;
- Need for grid codifying requirements;
- Solutions for power evacuation challenges;
- Wind power plant modeling; and
- Modeling studies carried out at C-WET.

MOVE ON IN WRA UNIT

MNES is Funding for 50 new Wind Monitoring Stations

As a part of National Wind Resource Assessment activities, the Ministry of Non-Conventional Energy Sources (MNES) has sanctioned a project for carrying out wind resource assessment studies in uncovered/new area at 50 locations over the country for the year 2005-06. Programme will be implemented in association with State Government Nodal Agencies. New locations from 15 states and two Union Territories will be selected and studied under this project. The duration of the project would be 30 months, which included data collection for a period of 24 months. The project is started and site selection is going on. Total project outlay is Rs.380 Lakhs.

Project for NE Region

C-WET has commissioned one wind monitoring station with 25m tall mast at Dolangkhnou in Manipur as a part of the MNES sponsored project of Wind Resources Assessment in Northeastern (NE) region. A total of 23 wind monitoring stations have been established in the state of Assam, Arunachal Pradesh, Manipur, Mizoram, Tripura and Skkim in the NE region during the last year. One more station is to be established in Assam.

Others Activities

C-WET has verified the procedure of wind data collection done in Phalodi & Bhalu Ratangad in Rajasthan and Birenwadi in Maharastra for M/s.Suzlon Energy Limited, Pune

A "Background paper on offshore wind energy assessment in India" is being prepared for Technology Information, Forecasting & Assessment Council (TIFAC), New Delhi.

STEPS FORWARD IN TESTING UNIT

The testing Unit has started the preparatory works at WTTS, Kayathar for two Provisional Type Testing projects namely Suzlon 600 kW with 52 m rotor diameter and IWPL 250 kW with 29.5 m rotor diameter. The site evaluation of Suzlon 1250 kW with 69.1 rotor diameter in Gujarat is expected to be completed in March 2006 provided the category for testing is decided as Category II. The unit has also initiated actions to purchase equipment to cater to the needs of additional testing assignments. The laboratory of the unit is being equipped with in house functional testing of sensors and transducers and also with a working model of a wind turbine for training purposes for new staff in instrumentation and data acquisition. Also as a part of continual improvement in the QMS system the policy for calibration of sensors/ transducers and various procedures of the unit have been reviewed and implemented.

The Unit has initiated actions for the final external audit by NABL for International accreditation by sending the revised Quality manual in January 2006.The final external audit is expected to be completed in the month of June 2006 and preparations are on going

MARCHING AHEAD IN S&C UNIT

- Successfully concluded the Provisional Type Certification of CWEL C2920/250 kW wind turbine model of M/s. Chiranjjeevi Wind Energy Limited. Pollachi, under category-I, as per TAPS 2000. The Provisional Type Certificate has been issued by the Hon'ble Secretary, MNES on 22nd February 2006.
- Successfully concluded the Provisional Type Certification of Pioneer Wincon W250/29-250 kW wind turbine model of M/s. Pioneer Wincon Private Limited, Chennai, under category-I, as per TAPS 2000.

- The renewal of Provisional Type Certificate of Vestas V-39 500 kW with 47 m rotor diameter of M/s. Vestas RRB India Limited, Chennai has been initiated.
- As a part of Provisional Type Certification of Suzlon-600 kW wind turbine, a technical specification verification has been carried out on the test site turbine installed at WTTS, Kayathar.
- The preparation of draft Indian Standards on wind energy and formation of working group of wind energy have already been completed. The first meeting of the working group is scheduled to be held on 05.04.2006.
- A meeting has been held on 10.01.2006 with various stakeholders of the wind turbine industry to demonstrate the prototype software developed for MNES for Issuance of Concessional Customs Duty Certificate and comments have been received.

World-wide Installed Capacity of Wind Power

World-wide installed capacity of wind power by the end of December 2005 has reached to 59206 MW. The first five countries are Germany (18,427 MW), Spain (10,028 MW), USA (9,142 MW), India (4,434 MW) and Denmark (3,127 MW). (Source : Wind Power Monthly – April 2006).

WIND MEASUREMENTS

One of the important requirements for the successful implementation of wind power project at a location is the understanding of the wind resources available at that location.

Fifty percent of the successes of the design of an economically attractive wind farm lie in the correct assessment of the wind potential. A quality wind resource assessment programme is the combination of sound siting, measurement techniques, quality equipment and data analysis techniques.

Wind is a vector quantity specified by two numbers representing its direction and speed. According to meteorological convention wind is the horizontal component of air motion. Wind direction is regarded as the direction from which the wind blows and is expressed in degrees measured clockwise from the true north or in terms of the points of the compass.

Surface winds are measured in the boundary layer near the earth surface using ground-based sensors. The surface wind is rarely constant over any appreciable period of time and usually varies rapidly and continuously. The variations are normally irregular both in period and amplitude.

A wind resource measurement programme at any sound sited location should be such that it needs to meet the wind energy programme objectives. The programme should specify at least the following parameters

- Measurement parameters
- Equipment type and quality
- Sensor measurement levels
- Measurement accuracy, duration and data recovery
- Data sampling and recording intervals
- Data storage format
- Data processing procedures
- Data reports

Measurement of wind characteristics should be made at intended hub height and at a location well representative of the site considered. This is important in areas of rough terrain and where local circulation might develop.

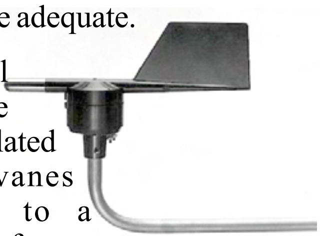
Wind measuring systems consist of sensors, signal conditioning units and displays or recorders. Most wind sensors consist of a physical device that is intended to follow the atmospheric motions. Different types of wind instruments are there depending on the requirement. In some cases the data collected will be for an over all climatology assessment and in other the requirement may be very precise measurements for research and development studies. Depend on the requirement, different types of wind instruments are there for measurement, the common being the horizontal wind or the three component vector winds. Also instruments are classified in terms of its capabilities i.e. some may be for continuous measurements and the other may be for occasional use. Even within this there are many variants from the simple mechanical types to very sophisticated microprocessor based systems. Thus the selection of instruments depends on the user requirement.

The basic wind sensors are anemometers for wind speed and wind vanes for direction. Cup anemometers are the most commonly used instruments for the measurement of near horizontal wind speed. In this at least one cup is always faces the wind and thus the aerodynamic shape converts the wind pressure to rotational torque. The cup rotation is linearly proportional to the wind speed over specified range. Anemometers make use of the pressure, Kinetic energy or the cooling power of the wind to measure its speed. Rotating anemometer is the most commonly used wind instrument. The signals could be continuous or intermittent. Continuous signals permit the wind speed to be determined at any instant where as the intermittent signals can be used only to determine the average speed during a specific interval.

Though many type of anemometers are available cup or propeller anemometers remain the most appropriate instruments for the measurements of wind parameters for wind resource assessment.

Specifications	Anemometer
Measurement range	0 to 50m/s
Starting threshold	<1.0m/s
Operating temperature range	-40 C to 60ºC
Operating humidity Range	0% to 100%
System error	<3%
Recording resolution	<0.1m/s

Wind vane is used to measure wind direction and it is fundamentally a body-mounted unsymmetrical about a vertical axis, on which it is free to turn with a pointer at one end and a flat at the other. The most familiar one is the one with a fin connected to a vertical shaft. The vane constantly seeks a position of equilibrium by aligning itself into the wind. Most wind vanes use a potentiometer type transducer that outputs an electrical signal relative to the position of the vane. Wind vanes produce continuous signals and these signals will be either indicating discrete direction sector thus showing a constant value for a sector or the other type indicates the instantaneous direction. For most of the wind resource related studies wind vanes that relate direction to discrete wind sectors are adequate.



The signal from the vane is related to the vanes position to a known reference point (usually true North). Thus the alignment of the vane to a specified reference point is important.

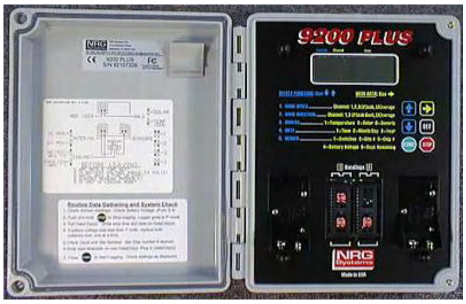
The selection of a display system depends on the users need. Microprocessor based automatic data loggers are the commonly used with facility to record signals from multiple levels and sensors.

Specifications	Wind vane
Measurement range	0 to 360^0
Starting threshold	<1.0m/s
Operating temperature range	-40C to 60^o C
Operating humidity Range	0% to 100%
System error	<5^o
Recording resolution	<1^o

These systems have facility to process the signals and dumping the processed data into separate memory holds. The data stored by the data logger is in binary format and the storage device could be a non-volatile device where by the ability to store data is not affected by loss of system power. At site data is stored in an EPROM or EEPROM or Flash card. These can be brought to a central place and processed through appropriate reader and software to give data in an ASCII format. Alternatively the data from the data logger can be downloaded into laptop at the site or send through modem (remote transferring of data) to a central computer centre.

The selection of wind monitoring system for wind energy assessment depends on system accuracy, reliability, suitability and cost while quality of wind sensor depends on its responsiveness, accuracy, precision and reliability. The quality of data collected is measured in terms of its representativeness, accuracy and completeness.

In wind resource assessment related studies the upper–level sensors should be mounted at least 0.3 m above the tower top to minimize the tower shading effects. ·Sensors preferably to be mounted on independent booms. Long mounting hardwares are to be used if the sensors are to be positioned off the side of the tower. In the case of lattice towers the position of the sensor should be at least 3 tower widths and 6 tower diameters in the case of tubular towers. For triangular lattice towers the tower width is measured as the length of the one face.



The sensors should be mounted off the tower side into the prevailing wind direction. Data are more representative of the surrounding area where the terrain is relatively flat. In complex terrain the application of data beyond stations immediate vicinity is limited. The wind increases rapidly with height near the ground and is greatly affected by the presence of irregularities in the ground or by the obstacle such as trees and buildings. Obstructions may adversely affect the wind readings thereby the wind characteristics of the site.

In normal meteorological practice the standard exposure of wind instruments over level open terrain is 10 m above ground. But in the case of data collection for wind energy applications the exposure of instruments should be such that absolute openness be there at least for the prevailing wind sectors or in other words the instrumented mast should be as far away as possible from local obstructions to the wind. Thus the location should be representative of the majority of the site. The wind measurement at a standard height of 10m may be applicable to small WECS with typical height close to 10m. But in the case of large WECS with the heights 50 to 100m where the wind energy would be about 2 to 3 times the 10m values. Thus it should be kept in mind that wind data from meteorological stations under estimate the actual wind energy evaluations.

Wind speed data is the most important data that indicates the wind resource of the site. A tall mast of desired height (preferably 50 m tall or more) with multiple measurement levels is required as the study not only gives the wind resource at the desired levels, but also the wind shear characteristics of the site. The level of instrumentation could be such that the study generates data for the hub height as well as for the minimum level reached by the blade tip of the rotating turbine rotor. This will help to define the wind regime encountered by the rotor over its swept area. The universal standard height of 10m also can be considered for measurement apart from additional levels of choice.

Time series values of wind direction data needs to be collected at all possible levels especially the hub height and at the minimum height reached by the blade tip portion of the rotating turbine rotor. The detailed direction data is necessary for optimizing the wind turbine out put in a given area. Apart from the speed and direction data, temperature, pressure and solar radiation data also can be collected. The basic parameters should be sampled one or two seconds and recorded as averages, standard deviations, maximum and minimum values. In the case of wind energy related programme, the standard is a continuous wind measurement, either 60 minute average based on 1 or 2 seconds sampling for a general resources studies or six 10 min average values of wind speed and direction for each hour for better temporal resolution for micro level studies.

The reliability of wind power production and wind energy density calculations depends on the reliability of the data from the Met mast from which wind statistics have been derived i.e. the accuracy of the wind speed and direction measurements, the exposure of the instruments, the manner in which the data is registered and the amount of data available. Minor variations in wind speed due to instrument exposure or accuracy can result in substantial errors in the wind power estimates. Since wind power varies as the cube of wind speed the distribution of speed rather than the mean wind speed is needed to calculate the power resource.

Significant variations in the mean monthly wind speed or the mean annual wind speed can occur from one year to another. Minimum one calendar year data should be there but probably two to five years of data is needed to establish a sufficiently accurate wind climate. Two years of data should be sufficient to give a sample annual mean wind speed within 10 % of the long-term mean. To reduce the uncertainty to 5 % would require about 4-5 years data. The data recovery for all the parameters measured should be at least 90% over the duration of the program.

The tower could be either lattice or tubular with the later have clear advantages. Tilt-up guyed types are favorable because of its ease of installation, minimal ground preparation and relative low cost. The tower height could be such that upper level measurement should correspond to the hub height.

The sensor mounting consists of the booms to fix different types of sensors viz wind speed, wind direction, radiation, temperature, pressure sensors etc. The booms should be sufficiently long to minimize any influence of the tower itself and properly oriented into prevailing wind. Grounding facility is essential when electronic data loggers and sensors are used to collect data. Electrical surges, lightning induced spikes or surges or difference in ground potential are potential problems that may cause sensor failures or data logger failures. Thus tower as well as data loggers are to be protected from such events.

The integrity of the wind resource assessment system at a location should be maintained by periodic field visits as well as its documentation to ensure the smooth and continuous data collection. This will ensure high level of data recovery. Field visits enable one to take remedial action due to instrument outages.

R.Sasikumar, *Meteorologist,*
Wind Resource Assessment Unit, C-WET

The second international training program on "Wind Turbine Technology and Applications"

The Centre for Wind Energy Technology (C-WET) had organized an international training course on "Wind turbine technology and applications" during 22nd February – 3rd March 2006 sponsored by MNES, Government of India. It was designed to help the countries China, Iran, Sri Lanka, Cuba, Saudi Arabia, Mauritius, Yemen, Uganda, Bangladesh and Thailand in wind farm development. The objective of the training course was to transfer knowledge and special skills needed by the wind energy personnel working in the technical and operational fields and to share the experiences from the lessons learnt over the last two decades. The course provided an invaluable platform for dialogue and open exchange of views and experiences. The course content for the training was a carefully thought out syllabus with subject experts giving lectures and quoting specific case studies.

The training programme was inaugurated by Mr. V. Subramanian, Secretary, MNES. Eminent speakers from the wind energy sector conducted grueling yet enlightening sessions covering the entire gamut of wind energy technology. Apart from theoretical concepts, visits to manufacturing facilities were organized during the course to give a complete picture of the know-how and process to go about setting up a coordinated wind energy programme at a national level. To make the training more interactive, the course participants were asked to make a presentation on "Country Policies and Perspective on Wind Energy", summarizing the learning at the training programme and their vision ahead. The training programme was well received and many more are being organized on the same lines in the near future.

ISSUES ADDRESSED

1. Wind Energy Evolution
2. Developments / breakthroughs
3. Government policies and supportive schemes & programme
4. Legal frameworks
5. Critical issues that India need to address
6. Improve levels of understanding among stakeholders
7. Determine ways and means of covering institutional barriers in a scientific manner
8. Design of carefully vetted wind farming projects
9. Improved performance of wind farms through the use of newly acquired knowledge
10. Key of global success
11. Investment techniques
12. Detailed description of success stories and focused cause studies
13. Integration of Wind Energy to grid
14. O & M aspects of wind farms

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An autonomous R&D institution established by the Ministry of Non-conventional Energy Sources (MNES), Government of India to serve as a technical focal point of excellence to foster the development of wind energy in the country

For more information :

CENTRE FOR WIND ENERGY TECHNOLOGY

Velachery–Tambaram Main Road, Pallikaranai, Chennai – 601 302 Phone: +91-44-2246 3982, 2246 3983, 2246 3984 Fax: +91-44-2246 3980

E-Mail: info@cwet.res.in ***Web :*** http://www.cwet.tn.nic.in

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