C-WET

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pavan

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

editorial...

In Wind Energy Technology applications, the stakes and risks are very high. Modern wind turbine technology uses some of the nascent ideas, which have no parallels and its design is a challenging multi-disciplinary effort. Some of the major issues are the advanced composites that go to make the blades to the 'embedded systems' that control the wind turbine. Wind Turbine blades are essentially structural composites with their origins in spin-offs from technologies developed for space applications. As advances were made in material research, carbon-carbon composites for advanced aircrafts and spacecrafts, the technology found its way to wind turbine blades. The lesson learnt while making such research products need considerable adaptation when applied to mass produced components.

The consequences of statistical nature of material properties, especially with respect to composites and their effect on the derived strength can be considerable. This in turn will have an impact on the derived service life expectancy of the components. While fatigue in conventional material is a science that has seen much research, application of same principles and methods for composite structures needs to be given its due consideration. Extended exposure to elements of nature cannot always be precisely modeled and taken into account. The limits or operational envelope set by the designer of the composite blade needs to be kept in view by the wind turbine designer. However, there could be certain dynamic factors all of which may or may not get incorporated into the design. An evaluation of such designs and design improvements should form a part of product development plans.

We are coming up with newer and improved models for use in India on the basis of sustained R&D to complement the highly heterogeneous terrain and environmental conditions in India. With the race to achieve higher capacity utilization factors at lowest feasible costs, many fundamental design principles could be reinterpreted. While doing so, it is important that a third party certification is obtained. In the brief history of modern wind turbine technology, there have been instances where some of the wind power majors have had to commit considerable resources for repairing their models. They showed commendable responsibility in such cases and were able to find solutions. Admittedly not withstanding the fact that the machines were developed by industry leaders and certified by equally reputed accreditation/standardization bodies, problems have caused some major technical and financial loss. These experiences emphasize the need for caution both from designers and certification agencies.

It is essential to note that certification of wind turbines would not merely a value addition, but a tool to ensure application of an objective and independent assessment for the benefit of the product. As a matter of fact most of the engineering products today have third party certification and here we are dealing with a complex engineering product. It is better to make hundred errors in one prototype rather than correcting one mistake in hundred machines.

M.P. Ramesh, *Executive Director*

contents

editorial board

NEWS NEWS NEWS NEWS NEWS NEWS NEWS NEWS

India third highest installer after Spain and Germany in 2004…
Suzlon World headquarters opens in Denmark…
KYOTO PROTOCOL comes into effect…

As late as 1850, 90% of the power used in Dutch industry came from the Wind

News Briefs from India and Asia Pacific

- The recent survey of World Wind Energy Association on country-wise Wind energy installations during the year 2004 reveals that India was third highest with 875 MW only after Spain (2061) and Germany (2019.7). India continues to be the leader in Asia. Japan (896 MW), had the highest growth rate (77.1%) in Asia.
- Suzlon Energy Ltd, Asia's largest integrated Wind power company, opened the office of its wholly owned subsidiary, Suzlon Energy A/S at the Aarhus Denmark - a hub for wind energy. Amongst the invitees were bankers, customers, vendors and other stakeholders. The Indian Ambassador in Denmark Mr. Harsh Bhasin graced the function by his presence.
- Maharashtra State Electricity Board plans to invest about Rs 1500 million to develop 40 MW of Wind energy informed State Energy Minister, Mr Dilip Walse-Patil during ICORE 2005 held in Pune in January 2005. The aim is to showcase the Maharashtra Government's commitment to support clean and green energy.
- Dr S.K. Chopra – Senior Advisor in the Ministry of Non-conventional Energy Sources said that Orissa has a potential for generating an estimated 1700 MW Wind power. Gopalpur, Chandipur, Puri, Chatrapur, Paradip and Koraput have been identified as potential sites in the state for installation of Wind turbines.
- With a view to meeting 5 percent of energy needs by 2011 through new and renewable energy sources, South Korean Ministry of Commerce, Industry and Energy has allocated funds worth 325.9 billion Won (US$313.8 million) during 2005. It includes the building of a Wind farm at a suitable location to meet the power needs of 100,000 households.
- Germany-based Infra Vest Group will set up 97 Wind turbines at Tungshih and Putai lying in coastal areas of southern Taiwan at an estimated project cost of NT$16 billion (US$500 million). Each of these turbines will be generating 51 million kilowatt-hours per year.

Press release from WWEA on Wind energy market shows that at the end of year 2004, worldwide the Wind power capacity grew dynamically and the cumulative capacity stood at 47.616 MW. A record 8,321 MW of new capacity were added in the year 2004.

News Briefs from Rest of the World

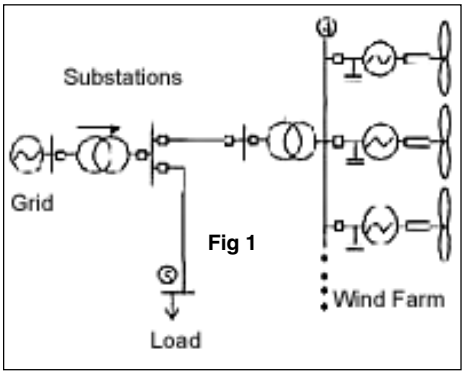
- The European Wind Energy Association (EWEA) signaled the great scale of the R&D work that remains to be carried out if the EU is to attain its objectives under, inter alia, the Lisbon Agenda, and the RES-E Directive; following dramatically reduced funding for Wind energy R&D under the European Commission's sixth Framework programme (FP6). EWEA has called for Wind energy to be reinstated as a priority research area under FP7.
- Multibrid Entwicklungsgesellschaft, mbH has installed its first 5 MW-prototype Wind Electric Generator (M5000) in the North Sea port of Bremerhaven, Germany. The blades are 56.5m long and nacelle is at a height of 102m and worldwide it is the lightest plant in this category.
- Dublin-based Airtricity is planning to build the world's biggest Wind farm in the North Sea at a cost of about £1.2bn. The turbines would be spread over almost 50 square kilometers and create enough energy to power 441,000 homes. Airtricity has also drawn up plans to develop Wind farms producing more than 10,000 MW of electricity.
- The World Bank has announced it will purchase renewable energy for all of its electricity usage at its Washington D.C. office from WindCurrent, a Maryland-based company that sells Wind power to the mid-Atlantic power grid. The Bank will purchase 85,000,000 kilowatt hours of renewable energy certificates (REC's), which are allocated for each unit of power from a renewable energy power plant (such as a Wind farm).
- The Canadian Government has increased its original 1,000 MW Wind Power Production Incentive (WPPI) to 4,000 MW. Under the WPPI, qualifying projects receive a payment of C$10 per MWh of electricity produced from Wind energy.

C-WET at work

Development in R&D Unit

Modeling of Interconnection of the wind turbines with the grid

The R&D Unit is carrying out a study on modelling of interconnection of the wind turbines with the grid .The objective of this study is to develop a simple tool to study the grid interaction of wind turbines, to determine the contribution of the Wind turbine in governing the behavior of the grid and study the planning and control strategies involved in the implementation of a wind farm. The methodology of the study is to develop a simple tool in MAT LAB to study the grid interaction of wind turbines and to validate the model through real-time measurements in field.



Network considered for the simulation

Two approaches are considered while modeling the wind farm. In the first approach a wind farm consisting of a typical 15 wind turbines is modeled, in which each wind turbine is individually represented. The second approach involves aggregating the group of wind turbines. Simulations will be carried out for reactive power compensation using fixed capacitor and FACTS devices and three wind regimes i.e. high wind, moderate wind and low wind to study the behavior of wind turbines under different schemes. The model will be validated through measurements in field in the forthcoming windy season.

Parameterisation of flow distortion around wind turbine nacelle

The Unit is also carrying out a study on 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 very less uncertainties in complex terrains. The fabrication of the model has been completed and experimentation will be conducted through a wind tunnel experiment.

Scaled model of the nacelle and tower

Move on in WRA Unit

Wind Monitoring in the Northeastern region

The Ministry of Non Conventional Energy Sources (MNES) has launched a special programme of Wind Resource Assessment in Northeastern region of the country and as a part of the programme C-WET has installed 9 stations with 25m tall masts in the four states during January 2005 to March 2005. The stations commissioned are P. Leikul (Assam), Chawangkining & Phangrei (Manipur), Sakawrhmuituai, Reiek & Hmuifang (Mizoram), Phuldangsai Tilangsang and Vanghmun (Tripura).

25m wind monitoring mast at Sakawrhumithai, Mizoram

Wind Monitoring Programme in Goa

One wind monitoring station with 50 m tall mast with instrumentation at three levels was commissioned in January 2005 at Loliem in Goa under a programme of Wind Resource Assessment in Uncovered / New areas funded by the MNES.

Project on Measure – Correlate – Prediction Method for Wind Resource Assessment

C-WET has initiated a project to validate what is known as Measure, Correlate & Predict (MCP) procedure under Indian condition. Normally it is difficult to get long-term wind data in wind farmable areas. In most cases, wind-monitoring stations would be closed down at the end of two to three years. In many cases it will be difficult to get even one full year's data. The data behind the MCP method is that the long-term data available from meteorological sources could be used to

obtain long term-averaged winds that are more representative of the site's wind characteristics. The procedure is to take concurrent data sets and establish correlation between the long-term and short-term data sets. Use these correlation coefficients to obtain a synthetic data sets for the site under consideration. This could then be used for calculating win farm outputs with a better confidence levels.

Under this programme a 50 m tall mast with three level instrumentation was commissioned at Majlatti near Chikkodi wind monitoring station in Karnataka in January 2005.

Steps forward in testing unit

The Testing Unit had signed up with M/s Enercon India Ltd. and M/s NEPC India Ltd. to test their 800 kW wind turbines for the windy season 2005. The projects will start during the month of April 2005 and end during the month of September 2005. The unit is also expecting two more wind turbines for Provisional type testing for the current year and preparations are on going.

The Pavan Shakti 600kW measurement project at Coimbatore is currently in full swing and the measurements of all parameters are expected to start during the third week of March 2005.

Marching Ahead in S&C Unit

Enercon E-48, 800kW with 48m rotor diameter has been taken up for Provisional Type Certification.

The renewal of PTC of VESTAS V39-500kW with 47 m rotor diameter has been taken up.

Current Activities:

- The certification of projects taken up as per TAPS-2000 is under progress.
- The continual improvement and maintaining the Quality Management System are on going.

Highlights form ITCS Unit

National training course

The second National training programme on "Fundamentals of Wind Turbine Technologies" was organized successfully on 10th and 11th March 2005.

The idea was to address all aspects of Fundamentals of Wind Turbine Technologies from wind resource to

Training participants in front of C-WET Office

aerodynamics & wind turbines and wind electric generator in a focused manner.

The participation strength was around thirty persons and the following topics were covered in the training, Blade theory and Power Regulation, Types of Generators in Wind Turbine, Wind Resources & Assessment Techniques, Grid Integration of Wind Turbines, Analysis of Lattice Tower and Foundation Concepts, Overview of Wind Turbine Design, Control and Protection System Requirements, Certification of wind Turbines, Power Curve Measurements, Mechanical Loads and Operation & Maintenance of Wind Turbine. All the lectures were delivered by the C-WET scientists/engineers. The participants were also taken to the 55 kW Wind turbine nacelle facility for a hands on experience.

Training participants visiting the Nacelle facility at C-WET

Redesigning of Website

The process of redesigning the lay out of the existing website is on for effective information dissemination on the wind energy sector and C-WET activities.

Library Automation

C-WET has established a well-equipped library in its campus with increased strength of literary resources, books and periodicals and the automation process is in progress.

Training on Internal Auditor

As a part of accreditation activities of Testing unit, a training programme on "Internal Auditor as per ISO/IEC 17025" was organised for C-WET Scientists / Engineers, during 21st – 23rd February 2005. This training was conducted by Centre for Electronics Test Engineering (CETE), Bangalore.

New Facility

C-WET has installed a 55 kW Wind turbine nacelle in its premises for demonstration to public, students as well as for the purposes of Research and Development. It was presented by M/s NEPC India limited, Chennai and is indigenously developed.

55 kW Wind turbine nacelle in C-WET

Within the nacelle, a low-speed shaft connects the rotor's hub to a gearbox with ratio of 1/18 (Elecon Make), which steps up the speed of rotation. A high-speed shaft on the other side of the gearbox connects an electric generator (55 kW Generator with 1000 RPM, 415 V 96 A).

Experience of Successful Wind Power Projects

Preamble

Amongst the different Non-Conventional Energy development in India, wind power in the last decade has taken a big leap in adding more than 3,000 MW capacity, and the assessed potential is approximately 45,000 MW.

It is known universally, that the wind power plant load factor (PLF) is low, unlike other conventional power plants. The fuel is free. The wind power projects had been sustainable with the government support subsidies. Even otherwise it can be viable if the wind regime is good, project costs can come down or if the utility company's power tariff continues to increase year after year as was the practice earlier. It is generally assumed that these wind power projects shall have a life cycle of approximately 20 years.

The nation has wide range of wind sources (as per available data of Wind speeds & Wind Power Density) and grid conditions. It has also different utility companies, affected by many operating constrains. It is true that there is going to be healthy and competitive atmosphere with new Indian Electricity Act, 2003. However, there is urgent need for a uniform Renewable Energy Policy with clarity and also probably some compulsion on utility companies to go for more and more Renewable Energy power generation as a part of their generation / purchase of power. This shall create an atmosphere of friendliness in everything to integrate Renewable Energy with other fossil power production and distribution.

It is agreed that complete handholding or subsidy supported Wind Power Project development is not the right method; that too for the present already matured market levels. However, the speedy resolution of many issues by the Government and respective utilities is essential for fast paced growth. I am sure once these are set in, with a clear national policy and as accepted by all the utilities and Government Nodal Agencies, Manufacturers / Developers can set up projects at more competitive and realistic costs. This shall have the benefit to not only to all the stakeholders but also to the utilities power consumers.

All over the world amongst different renewable energy sources, Wind Power had faster growth. I presume reasons are speediness with which these projects can be done are: technology advancement, change in cost economics scenario, easy adaptation of technology in developing countries and finally not but the least, local Government policy support.

In India there had been mostly private investments in the last decade and generally the project returns have been satisfactory. But however, it has not been up to the expectations or matching with the hype generally created at the time of project selling by the developers or manufacturers.

It is interesting to note that such wind power development in remote areas has also been helping the social cause of rural development, of uplift of economy, employment opportunities, a possibility of vegetation improvements in hilly areas. Otherwise, there was no approach to some of these uncultivated lands, earlier.

The paper shall share the thoughts from the success story of Kalyani Group setting up the wind farm projects of capacity 22.53 MW, third largest capacity by an investor in Maharashtra, now in managing the same for optimum generation. The author shall try to convince in the paper about the facts, as seen in any other similar high value investments, the importance of good Operation & Maintenance, the necessity of close monitoring of these distant location projects to get good returns.

Other than machine selection, the key factors for good performance of a project also depend upon –

- Wind regime
- Micrositing
- Project implementation process
- Power Evacuation
- Operation & maintenance (O&M)

These factors can be independent of the technology or the selection of machine. Generally in India, the manufacturer or the developer decides the location, within the recommended regime as they first select the location and take possession of the same much before deciding who the investors are. These lands are either directly purchased from the private landholders or get allotted from the Government forest department.

The high expectation from Wind Power Project starts getting verified on commissioning of the project. Once there is difference in generation from the expected or promised, the analysis starts. It may end always, getting some reason, like cyclical changes in wind or initial evacuation problem etc. These may be right in some projects. But for some, it may not be true for the lifetime of machine.

We generally are able to examine the following to understand what could be the reasons and analyze for any of them to be improved.

A.

- External grid availability
- Internal grid availability
- Machine availability
  - Breakdown related
  - Preventive Maintenance and Corrective Maintenance
  - Balance hours wind not available

B. Standardization in project execution for ease of maintenance and parts replacement

C. Machine Maintenance

Importance also to be given to smaller issues

- One should anticipate and prepare
- Providing adequate support during high wind season

D. Special Tools

Key factors that influence the performance of the Wind Power Project are as follows-

- **Wind regime**

Amongst key factors for performance, it is generally taken for granted that the manufacturer or developer has gone for the good wind regime region. This is derived either from the wind data generally made available from MNES or from the reference of other good performance projects nearby. It is not possible to expect, always the same Plant Load Factor (PLF) as that of the nearby reference projects, since there are so many other factors influencing the generation and not just by the selection of the wind regime or region (within the state) selected.

- **Micrositing**

This is a science of deciding the locations of turbines within the selected regime and the lands which are made available either by direct purchase or from the allocation of government / forest lands. The distances between the machines in reference to the predominant direction of wind are most critical. Even though different thumb rules are available and practiced, the distances need to be fixed after studying the specific site. It is inappropriate to decide first the MW – capacity, one could like to set up the project, then arrive at the number of turbines of selected capacity (of each turbine) and some how locate all of them, which decide the desired MW installation in the considered land area.

Instead it is essential to have reasonable PLF as the target and decide (the grid) locations, thus arrive at the appropriate micrositing for optimum generation. This would lead to least cost of investment / KWH generation. It can happen that the importance for micrositing may not be fully given. One can argue that even then, the expected generation may not come, based on the grid selected. But the reason for this may be that the many assumptions made about the characteristics of the site, in arriving at the grid needed better fine-tuning.

- **Project implementation process**

There are many elements in project establishment to get optimum power generation. Even though some of these events are not reversible after knowing the generation variation, from the expected output. One should review what has gone wrong and make suitable improvements in this process for future projects by the developer or even by the serious investor. Unfortunately the seriousness given for these elements are very minimal as all are bound by the time factor for completion.

The deadline of project completion generally are related to financial account closing date. However, with the deferred tax liability provisions and also MAT etc. this may not get the same importance these days. But either the developer or manufacturer would have some target figures or the investor would look for cash flow advantage commitments.

Some of the elements which can go wrong in the consideration for best uptime during the life time of the machines are generally understood by the operating people and is very rarely shared with project personnel.

- **Power Evacuation**

For general public it is always a mystery why Wind Power Projects need to depend on the availability of grid power. The generated power can only be transferred (evacuated) when there is power supply in the connected system. If the utility companies keep their supplies (substation) switched off, the wind turbines cannot generate even if the wind is available.

So the evacuation of power not only becomes very critical but also its quality i.e. parameters like voltage, frequency etc. also are important. The performance of the project is totally dependant on these factors. Low voltage supply of the utility can bring down the generation of the turbine even under good wind speeds. Even at the time of conceiving the project, one should ensure the grid interconnection is taken care for the least interruption with a good substation of higher voltage. It should not certainly be connected to nearby rural feeders. These are continuously subjected to local problems and constrains of frequent load shedding. Even if one has invested in an exclusive long distance independent feeder for the wind farm, it is essential to maintain the same and manage the best uptime of the same for optimum generation.

- **Operation & maintenance (O&M)**

The importance of this is common for any capital-intensive investment. The return on investment as configured is highly dependant on this. However, the seriousness given to wind power projects again can vary from project to project. Thus even the so called "well-maintained wind farms" can have continuous improvements and gain incremental generation for the same input and at same cost of operation, which is generally expected to be committed for a specific period, if not for the life time of the turbine.

Hence, the degree of seriousness to harvest the maximum within the available opportunity is always to be stressed. The projects being remote, it is difficult to have the type of monitoring required in line with what generally would have been for an equivalent capital investment! The amount of efforts put in such well-managed production units is not at all comparable with that what is generally made available for such wind farms. Some times, it is because of complacency due to the typical revenue stream, enjoyed and the extra efforts or all investors do not practice reviewing the project performance

in different approach-improvement mode.

Even in O&M programs, good opportunities are there to reduce downtime, not only in the machine but also for the grid related items. One need not stress that the power evacuation elements either within the wind farm or in the external lines is so important that even with high quality performing machines, one can loose generation for hours and even days for a simple grid related component failure. So equal importance should be given for these support items at the disposal of site staff apart from machine maintenance with the right trained skills.

One should not ignore the fact the adaptability of the technology to suit the Indian conditions; more so the specific site conditions play a major role in the success of the story, however much the same technology has been successful in other parts of the world. Here only it is needless to mention the data collection on the various aspects of the machine behavior shall help in getting the fine-tuning done in the much earlier days of the machine working to build in long trouble free life for the turbine. Here only the role of both the manufacturer and also the investor is important to set this pace from the beginning.

In brief, this paper summarizes the various factors one should look at while planning a wind power project and also brings in awareness that continuous improvement with the urge to gain every additional unit of power under the same quantity of available free wind input.

With such an objective approach, there is a possibility of improving for not only completed project but also one can have better generation from the future Wind Power Development Project programs.

Courtesy: *A.S. Karanth, CEO, BF Utilities Ltd, C/o Bharat Forge Ltd., Pune, E-mail: askaranth@vsnl.com, askaranth@bharatforge.com; Tel: 98231 35460*

India: Third biggest market for wind energy

India has established itself as the third biggest wind energy market worldwide in terms of new installations, and 875 MW was added during 2004. The country is expected to get ahead of the former pioneer country Denmark — with an increase of only 7 MW—soon and become number four in terms of total capacity.

8,321 MW of new capacity were added in 2004 as against 8,129 MW in 2003. The new leader in terms of new installation was Spain with 2,061 MW, thus for the first time taking over the number one position from Germany (2,020 MW). Germany, however, remains the leading country in terms of overall capacity representing one third of the global wind energy installations. The Australian-Pacific region showed the highest growth rates of all continents: the installed capacity reached 547 MW compared with 233 MW in 2003, equalling a growth rate of 135 per cent. However, the global rate of growth fell from 26 per cent in 2003 down to 21 per cent. This is due to the fact that the wind industry has lost momentum, especially in former traditional core markets like Denmark, USA and Germany.

Asia represented 4,726 MW or 9.9 per cent of the global wind energy market in 2004 (in 2003, the share was at 8.2 per cent). India is the leading wind energy market on the Asian continent with additional capacity of 875 MW, and a growth rate of 42 per cent. Amongst the leading countries in Asia are Japan (896 MW), which had the highest growth rate in Asia (77.1 per cent) amongst the major Asian markets, and China (764 MW), which after the World Wind Energy Conference 2004 and the recent approval of the renewable energy legislation, is expected to have substantial further growth in the near future. It is interesting to mention that Japan, with an additional capacity of 390 MW, has topped the United States and represented the fourth largest wind energy market worldwide in terms of new installations. Another interesting market in the coming years is going to be Pakistan where the government has approved an ambitious wind energy programme.

Worldwide wind energy installation as on December 31, 2004

	Installed Capacity 2004 (MW)	Installed Capacity 2003 (MW)	World Market Share in 2004 (%)	World Market Share in 2003 (%)
Africa	391,7	271,5	0,8	0,7
America	7.335,5	6.842,6	15,4	17,4
Asia	4.726,0	3.217,6	9,9	8,2
Austria Pacific	546,9	233,5	1,1	0,6
Europe	34.616,4	28.730,2	72,7	73,1
World	47.616,4	39.295,3	100,0	100,0

Source: *www.projectsmonitor.com*

New and Renewable Sources of Energy Potential and Cumulative Achievement

(As on December 31, 2004)

Energy Source	Potential	Cumulative Achievement
Biogas Plants	120 lakh	36.71 lakh
Improved Chulhas	1,200 lakh	339 lakh
Wind	45,000 MW	2,980 MW
Small Hydro	15,000 MW	1,693 MW
Biomass Power/ Cogeneration	19,500 MW	727 MW
Biomass Gasifiers	–	62 MW
Solar PV	20 MW/sq. km	191 MW
Waste- to- Energy	1,700 MW	46.50 MW
Solar Water Heating	1,400 lack sq. m Collector Area	10,00 lakh sq. m Collector Area

Source: *MNES Annual Report 2004-05*

Tamil Nadu leads the Wind Power Development

The installed capacity of wind power in India as on 31.12.2004 has reached 2980 MW, with a record addition of 496 MW in a period of nine months from April to December 2004. The State of Tamil Nadu has contributed an installed capacity addition of 316 MW during the above period accounting for about 54% of the national achievement.

The Tamil Nadu Government has made this possible through resource assessment studies in 67 stations, timely setting up of demonstration wind farms at potential occasions, conductive and consistent policies, including attractive wheeling and banking facilities, with intensive promotional efforts, providing infrastructure for easy accessibility and power evacuation., helping motivate the private sector to invest in wind electricity generators for power generation on a large scale. Further the Textile Upgradation Fund (TUF) of the Ministry of Textiles, Government of India has also helped power- intensive textiles invest in wind mills in a big way and reduce power charges and control the cost of production.

A 2 MW Wind Electric Generator has recently been inaugurated at Chettikulam in Tirunelveli district, Tamil Nadu by the Hon'ble Chief Minister. The 2 MW Wind turbine is estimated to generate about 65 lakh units annually and it is the largest in India and also in Asia, towering at a height of 80 meters with rotor diameter of 88 meters.

Source: *MNES Annual Report 2004-05*

Events, Meetings, Seminars, Conferences and Trainings

May 2005, USA
WINDPOWER 2005 Conference and Exhibition
May 15-18, 2005, Denver, Colorado,
Contact: Kim Dresser at (202) 383-2503
E-mail: kdresser@awea.org

May 2005, UK
World Renewable Energy Congress (WREC2005)
May 22 -27, 2005, Aberdeen, Scotland, United Kingdom
Contact: Victoria Withy
E-mail: WREC2005_AT_aecc.co.uk
www.wrec2005aberdeen.co.uk

October 2005, DENMARK
Copenhagen Offshore Wind Conference and Exhibition
October 26-28, 2005, Bella Center, Copenhagen, Denmark
Contact: Jakob Lau Holst
E-mail: jh@windpower.org
http://offshore.windpower.org

November 2005, AUSTRALIA
4th World Wind Energy Conference & Renewable Energy Exhibition
November 2-5, 2005, Melbourne, Australia
Contact: Peter Rae
E-mail: wwec2005@meetingplanners.com.au

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