C-WET

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

editorial . . .

Recently in a workshop organized by CPRI, Bangalore I had the opportunity of listening to a very concerned set of engineers making presentations on how a paltry 400 MW of wind is causing instabilities on a 7000 MW grid. On a parallel I get to read that more than 27 % of energy requirement in Denmark is met with by wind power systems. Wind turbines we have today are practically same as those in Europe. Much is made of the load cycles and lack of dispatch ability of wind power.

Two issues need to be addressed here. First is that the grid management has its own problems with or without wind being a part of energy mix. If one looks at load scheduling, not withstanding predictable heavy industrial consumption, one has to contend with the irrigation pump sets that need to be powered at some point in the day or night at tail end of over extended grid lines and commercial loads that come on a regular basis between 6 pm and 11 pm causes a major stress for the grid management. It is not as if utilities do not have spinning reserves to take care of fluctuations in load. They have to have them and generally made available. With the coming together of state operated and better managed grids, system improvement is there for all to see. Utilities take the stand that under ABT regime the value addition to the grid by wind power is not significant and needs to be very small so as not to matter. This view is highly detrimental to wind power producer. Attempts will also be made to demonstrate that much wind power on the grid causes avoidable financial burden on the transmission companies rather than helping them to meet the demand not to mention the stability related problems. However to say that grid stability is put on line by introduction of wind power is quite far fetched.

On the other hand wind industry on its part has to get its act together and initiate steps to address this issue. There are tools to come up with predictions on possible generation for next 24 hours. There are currently available methods to do this and in Europe it is being used where large scale deployment of wind turbines has taken place. The risk here is that if a minimum is guaranteed and not met, there will be penalties to be paid. In the long run, this is perhaps inevitable. A question comes up as to who is going to listen to such predictions and who will make necessary adjustments in grid so that wind power could be used with profit by the utility.

The next question is about who should be doing this and who would fund such a project. Since the matter, though scientific in nature, has commercial overtones and therefore there will be inhibitions as to the expenditure involved and uncertainties associated with such efforts. While C-WET can coordinate such an effort, considerable co-operation and financing will be required from the industry. At this time, one does get a feeling that the operation of wind farms is generally a complex operation and too many imponderables affect generation. Validation of different tools available needs a stable and available grid and many parameters influence this. Therefore it is not always easy to take up such responsibility particularly with the commercial angle to it. However it should be seen that with the virtually unstoppable growth rate in the field, grid connection and management is bound to become a serious issue and wind industry should not allow itself to be taken unawares. There is a definite need to address these issues in a holistic manner and be ready with scientifically justifiable strategies.

M. P. Ramesh, *Executive Director*

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editorial board

Centre for Wind Energy Technology to be upgraded

The Centre will try to enable the Chennai-based Centre for Wind Energy Technology (C-WET) to acquire international status, Union Minister of State for Non-Conventional Energy Sources Vilas Muttemwar said here on Thursday.

"We will strive hard to equip the C-WET as an international organisation. In a short span of five years, it had delivered quality products and outputs for the benefit of the wind industry," he said after inaugurating a two-day national training programme on "Wind Farm Development and Related Issues."

The Minister, who released a book — 'Wind Energy Resource Survey Volume VII' — brought out on the occasion, said it contained detailed wind information from 26 locations. "With the wind energy field becoming technologically mature, demand of data to be presented in a highly scientific manner has been addressed."

The Minister said he was happy to learn that the C-WET had been given the mandate to prepare an Indian wind atlas based on advanced modelling techniques. "This will be a very useful tool for easily determining new windy areas and it will help in refining potential estimates more accurately," he added. Delving on the importance of wind farm development and related issues, Mr. Muttemwar said wind power was poised for a major growth in the near future.

K. Allaudin, Chairman and Managing Director, Tamil Nadu Energy Development Agency (TEDA), outlined the State Government's initiatives in Non-Conventional Energy, especially in creating greater awareness among the masses.

M.P. Ramesh, Executive Director, C-WET, outlining the objectives of the training programme, said it would address major aspects of wind power, wind resource assessment to the project implementation and operations in a focussed manner. E. Sreevalsan of C-WET said C-WET had been established by the Ministry of Non-Conventional Energy Sources to cater to all scientific and technological needs of the wind energy sector.

Source : The Hindu, 02-09-05

Wind Energy gaining ground: Muttemwar

India's power generation from non-conventional energy sources will cross the two lakhs mega-watt in the next 20 years, according to Union Non-conventional Energy Minister Vilas Mutterwar. He was speaking at the in-auguration of a two-day training programme on "Wind Farm Development and Related Issues" during which he also released the seventh volume of the Wind Energy Resources Survey, held at the Centre for Wind Technology (C-WET) here on Thursday.

Among the non-conventional sources, India was presently the fourth largest producer of wind energy in the world after German, Spain, and the US, he said and added that the present generation of 3,600 MW would reach 45,000 MW in another 20 years.He said that C-WET would be upgraded into an international institution to provide international level certification for wind turbines.

Source : Indian Express, 02-09-05

Work at C-WET

DEVELOPMENT IN R&D UNIT

Monograph on " Recommendations on Design and Maintenance of Gearbox of Wind Turbines"

The Unit will soon bring out a Monograph to aid project consultants/ investors in addressing design aspects and O&M personnel responsible for maintenance of Wind Energy Converters. This Monograph has been prepared based on field studies on failures in gearboxes of wind turbines.

Study of flow pattern in Palghat Gap

Training was imparted to C-WET Scientists on operation, measurement and analysis of data using SODAR by Dr. Olaf, Scintech, Germany. The instrument will be used for study of flow pattern in Palghat gap and validation of power law index.

Demonstration on SODAR

Pungam oil generator in C-WET campus

A Pungam oil generator has been installed at C-WET premises as a move towards promoting renewable energy devices.

A DG set has been modified to run on Straight Vegetable oil. The engine starts and stops on diesel to eliminate the starting problem at low temperatures and reduce carbon deposition on fuel injector. The Pungam oil will be automatically heated to 60Ú C with a heater fitted on the fuel tank to reduce its viscosity and for better fuel efficiency. The generator will supply a 20 kW load.

20 kW Pungam oil generator

Some facts about Pungam oil

Experiments conducted to check feasibility of Pungam oil as a fuel indicate satisfactory performance. Problems faced may be choking of fuel filters and restricted fuel flow due to higher viscosity and availability of oil as it is seasonal.

MOVE ON IN WRA UNIT

Under the special study of wind resource assessment programme in the Northeastern region, one wind monitoring station with 25 m tall-instrumented mast was commissioned at Simong in the Upper Siang District of Arunachal Pradesh. With the

Wind Monitoring data collection at Phangarai, Manipur

commissioning of these stations a total of 19 stations have been established in the states of Assam, Arunachal Pradesh, Manipur, Mizoram and Tripura in the region. Five more stations are to be established in the region to cover also the state of Sikkim in the region.

Data collection from another forty five stations established under various programmes like Power law verification, measure – correlate – predict, wind resource assessment in uncovered /new areas, wind resource assessment in the coastal region etc are in progress.

Published the seventh volume of Wind Energy Resource Survey in India containing wind energy resource data collected from 26 stations covering the states of Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Madhya Pradesh and Gujarat.

STEPS FORWARD IN TESTING UNIT

The measurements for provisional Type Testing of Pavan Shakti 600 kW wind turbine at Coimbatore has been closed in the month of September 2005 and the analysis and reporting of the measurements are on going.

The power curve measurements of 950 kW NEG-Micon wind turbine at CitraDurga, Karnataka has been closed in the month of September 2005 and the measurement report has been finalized.

The measurements of Enercon 800kW wind turbine at Bamnasa, Gujarat are still on going and is expected to be closed in the month of October 2005. The measurements of 750 kW NEPC wind turbine are expected to start shortly.

The testing Unit has entered in to new agreements with M/s. Suzlon Energy Ltd for Provisional Type Testing of their 600 kW wind turbine at WTTS, Kayathar and 1250kW wind turbine in Gujarat in the month of August 2005. The measurements are expected to start shortly.

MARCHING AHEAD IN S&C UNIT

Completed Projects/Activities

- The renewal of NEPC 225 kW Provisional Type Certificate has been completed and Provisional Type Certificate has been issued.
- Draft Indian standards on Certification of Wind Turbines and Wind turbine Safety requirements, have been prepared and sent to BIS, New Delhi.
- Renewal of Provisional Type Certificate for NM 48/750 kW of M/s. NEG Micon India Limited has been initiated.
- S&C Unit has signed an agreement with M/s. Suzlon Energy Limited for Provisional Type Certification of their Wind Turbine model Suzlon S70-1250 kW Wind Turbine.
- S&C Unit has signed an agreement with M/s. Suzlon Energy Limited for Provisional Type Certification of their Wind Turbine model Suzlon 600 kW Wind Turbine. Surveillance Audit has been conducted by DNV successfully
- Revised List of Manufacturers of Wind Electric Generators has been issued on 12.09.2005.
- Software development for 'Concessional Customs Duty Certificate and Technical Support' for MNES has been initiated by S&C Unit, through M/s. National Informatics Centre, Chennai.

Current Activities of S&C

- The Certification 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 Third National training programme on "**WIND FARM DEVELOPMENT AND RELATED ISSUES**" was organized successfully on 1st and 2nd Sept. 2005.

Inaugural Speech by Shri Vilas Muttemwar, Minister, MNES

The course focuses on the general introduction to the wind turbine technology, characteristics of wind resources, wind farm design methodology and certification & testing related issues.

The participation strength was around 50 persons and the following topics were covered in the training.

Wind Resources and Measurement, Wind Farm Layout & Production Estimate, Basic Aerodynamics, Classification of Wind Turbines, Power Quality issues in Wind Farms, Certification of Wind Turbines, Power Curve Measurements, Wind Farm Management, Operation and Maintenance of Wind Farms, Project Management and Financing & Foundation Concepts of Wind Turbines.

Training participants in front of C-WET Office

Book Release

A book titled, **"WIND ENERGY RESOURCE SURVEY Volume VII"** containing wind energy resource data collected from 26 stations covering the states of Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Madhya Pradesh and Gujarat, was released by **Shri. Vilas Muttemwar, Minister of State (Independent Charge),** Ministry of Non-Conventional Energy Sources, Government of India on 1st Sept.2005 during the occassion of the inauguration function of 3rd National Training Course

Release of Book by Shri Vilas Muttemwar, Minister, MNES

Wind Resource Assessment Techniques

1. Introduction

In order to establish wind farms in successful manner it is important to have a maximum possible accurate estimate of wind resources at a given site. The potential energy yield from the wind varies with the wind speed to the third power, i.e. a site with 10% higher wind speed has an approximately 20% increased wind energy potential yield. Generally wind resource assessment is done in number of phases and the details are as follows. The methodology of wind resource assessment over a region of interest is indicated in Fig.1.

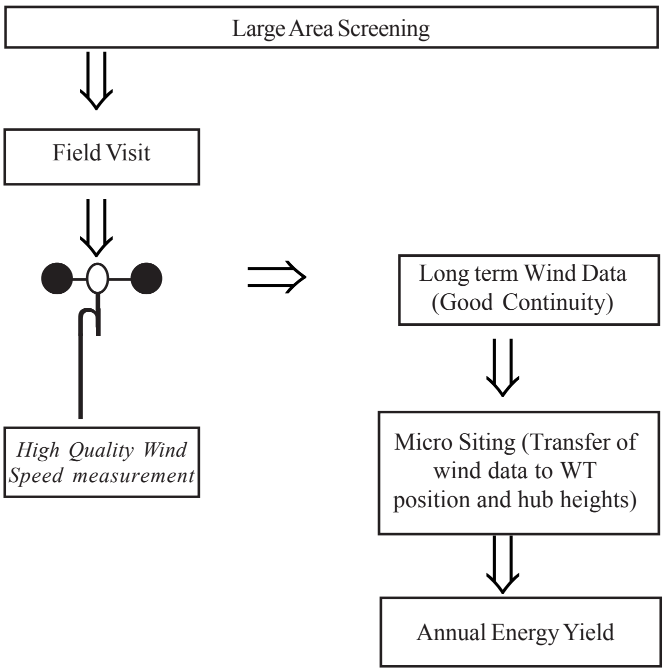

Fig 1. Wind Resource Assessment Methods

2. Large area screening & Field visit.

This phase may be appropriate if the region is large, if no previous wind measurement program has been conducted there. A large-area screening usually begins with a review of existing wind resource maps and other meteorological information, analysis of the meteorological characteristics of the state and their possible effect on wind speeds, and development of screening criteria (such as terrain form, land use / land cover and accessibility to roads and transmission). One recent approach to large-area screening uses geographical information systems (GIS), a computer mapping and analysis tool, to screen potential sites.

Once a preliminary list of sites is prepared, the next is to visit the site. One purpose of such visits is to look for physical evidence to support the wind resource estimate development in the large-area screening. Consistently bent trees and vegetation, for example, is a sure sign of strong winds. Another purpose is to check for potential siting constraints. A third purpose of the site visit is to select a possible location for a wind monitoring station.

3. Wind Measurements

Wind speed, wind direction, and air temperature measurements are required for useful wind resources assessment. Typically, each parameter is scanned every 1 to 2 seconds, and the data points are averaged by a data logger mounted on the tower. Data is normally collected at 10 or 60-minute average intervals. Historically, hourly averaged data have been used, but with the increased capabilities of wind models and computers, the 10-minute averaged data provide additional precision. The data logger calculates and stores the standard deviation of both wind speed and wind direction.

Wind speed is the most important measurement parameter. A 3-cup anemometer is the typical instrument. Several manufactures offer low-cost, highly accurate, and reliable anemometer that have been used in wind resources monitoring for years. Collecting speed data at multiple heights is preferred to avoid in simulating turbines performance caused by wind shears. For a 50-meter tower, measurements at 10, 25 and 50 meters are normal and for a 60-meter tower; measurements are at 10, 30 and 60 meters. Ten-meter data are the standard height for wind measurements. In areas that contain obstructions or vegetation, particularly within forest canopies, the lowest wind sensor is placed at a height that minimizes effects of surface roughness or obstructions. The 25- to 30-meter height is approximately the lower level that turbine blades reach in their down position. Turbine performance can be estimated better with these data. The models require data at hub height. If turbines with hub heights exceeding 60 meters are proposed, the cost to erect and instrument a taller tower is significant. For accurate wind speed data it is important to minimize the effect of the tower on the instruments.

Wind direction data are collected at the same heights as wind speed data. A wind vane is used for determining the direction. Optimal layout of the wind farm depends on good wind direction information. Air temperature data are needed to determine the air density term in calculating wind power density and turbine performance. This measurement may be made at 2 to 3 meters above ground. Measuring at this height minimizes the effects of surface heating during daylight hours. Additional data parameters – barometric pressure, vertical wind speed and precipitation – are recommended, but not mandatory.

The wind speed measurement period at the location must be long enough to cover all meteorological conditions in that region with a sufficient amount of data. Measuring over a period of one year can usually attain this. In order to account for seasonal or long-term variations of the wind potential the local short-term measurements must be correlated with instantaneous measurements of a nearly reference station that has collected long – term data. Once the relations between the local measurements and the measurements at the reference station have been established, the expected long term distribution of wind data all the predicted site is predicted by considering the local short term measurements according to the long term wind histogram. This procedure is often referred to as Measure, Correlate – Predict (MCP) method.

Wind speed measurements are among the most critical aspects for wind resource assessment. This is expressed by the fact that uncertainties in the wind speed are amplified by factor between two and three to uncertainties in the predicted energy production because of the non linear relation between wind turbine power output and wind speed. Due to the lack of experience a lot of wind speed measurement have unacceptable. Selection of anemometers, anemometer calibration, mounting of the anemometers, selection of the measurement site as well as the measurement height and the duration of the measurement are very critical process. An international anemometer calibration round robin comparison showed that uncertainties up to more than +/- 3.5% occurred in the calibrations in different wind tunnels. This translates into 10% uncertainty in energy yield prediction. Preferable one anemometer should be top mounted so that the flow field disturbance due to the booms at the mast is minimized. To avoid flow inclination effects the accuracy of the horizontal mounting of the anemometer is important as well. At the current state-of-the-art an uncertainty as low as 1-2% in the wind speed determination and about 3% in terms of energy production can be reached. Consequently it must be recommended to plan wind farms on the basis of high quality wind measurements within the wind farm area, especially in regions with complex terrain.

4. Micrositing.

Wind farms vary considerable in size and scale depending on the physical limitations of the land, the wind resource available and the amount of energy sought. In a wind farm, turbines will typically be placed in rows perpendicular to the prevailing wind direction. Spacing within a row may be as little as two to four rotor diameters if the winds blow perpendicular to the row almost all the time. If the wind strikes a second turbines before the wind speed has been restored from striking an earlier turbine, the energy production from the second turbine will be decreased relative to the unshielded production. The amount of decrease s a function of the wind shear, the turbulence in the wind, the turbulence added by the turbines, and the terrain. Spacing the turbines further apart will produce more power, but at the expense of more land, more roads, and more electrical wire.

In order to locate the turbines for optimum generation a careful exercise is to be carried out. Each turbine site must be selected based on topography and the optimum location where the highest wind power density are presumed to occur. This crucial step requires an experienced professional with a thorough knowledge of terrain effects on wind.

Micrositing can provide high quality and spatially detailed yield estimates over the wind farm area such that each turbine can be sited for optimal energy yield. Considerations much also be given to turbines interference and design constraints (visual, noise etc.) within the "wind farm design" stage. Finally energy estimates must be adjusted to reflect 7the likely long-term yield (typically 20 years) of the wind farm. The Micrositing process involves conducting surveys, monitoring and flow modeling at individual sites to quantify the small-scale variations in the wind resource over the area. In complex terrain, Micrositing may involve numerous wind speed measurements combined with computer modeling to predict speeds in areas where no measurements are taken.

There are several industry-standard techniques used in practice for modeling wind over a small region and later for Micrositing. Some of the models available in the market are Resoft WindFarm. WinPRO, WAsP, GH WindFarmer etc. All these models have limitations due to linearisation of the model equations. This restrict their applicability to low terrain slopes (e.g. < 0.3). These models are also limited by the fact that they do not take into account thermal effects such as sea breezes or mountain-valley winds. Though these models have some limitations, they can give good results if 'handled' carefully.

Micrositing Report for a wind farm consists (at a minimum) of the following:

- Description and maps of the site (in terms of Orodaphy and roughness)
- Characteristics of the turbine and wind farm (turbine dimensions, farm layout, power curve, and control systems)
- Description of the long-term reference site and internal wind speed variations
- Temporal variations of the wind (seasonal, diurnal, and turbulence intensity)
- Spatial variations of wind over the project area
- Air density adjustment for the site and site-corrected power curve
- Wind turbine array efficiency
- Wind turbine expected availability
- Electrical losses
- High wind hysteretic losses (losses near the turbine cut-out speed)
- Frequency of forced shutdowns by the utility
- Discussion of the uncertainties of all measurements and estimated
- Discussion of the uncertainty of the energy output estimate

While it is not possible to eliminate uncertainity from a wind farm development it is possible to quantify the uncertainity. By a careful analysis of the influencing factors it is possible to identify the uncertainities for each specific case.

Wind Resource Assessment Unit, C-WET

Energy Sources from Fossil to Renewables

Addressing the nation on the eve of the Independence Day, President A P J Abdul Kalam, staunchly stressed on the need for 'Energy Independence" and should be the nation's first and highest priority.

It must be determined to achieve within the next 25 years. 'Terming this a s "nation mission" that must be formulated, the President urged that funds be guaranteed and leadership entrusted without delay.

In his vision on energy, he further mentioned that by 2020 the nation should achieve comprehensive energy security" and by 2030 energy independence through all forms of renewable energy; maximum utilisation of hydro and nuclear power; an, though enhanced bio-fuel production. He categorically stated that for true energy independence, a major shift in the structure of energy sources from fossil to renewable energy sources is mandated. The target for renewable energy should be 20-25% from the present 5%.

C-WET is planning to organise the second international training course on **Wind Turbine Technology and Applications** during 13th to 24th February 2006 particularly for developing world. the objective of the training course is to transfer knowledge and special skills needed by the wind energy personnel working in the technical and operational fields and share the experiences from the lessons learnt over the last two decades.

The course content for the training is a carefully thought out syllabus with specific subject experts giving lectures and would go through specific case studies such that at the end of the day considerable useful knowledge transfer would be perceived. The training addresses the following aspects:

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 overcoming 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

Additional lectures and manufacturing facility visits would be organized during the course to give a complete picture of the know-how and how to go about setting up a coordinated wind energy programme at a national level. Participation is open only for guest country-sponsored candidates.

The Ministry of Non-Conventional Energy Sources, Government of India, wholly sponsors this course.

NATIONAL

ICORE 2005: International Congress on Renewable Energy for Sustainable Development : 9-11 Feb, 2006
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INTERNATIONAL

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