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A Newsletter from CENTRE FOR WIND ENERGY TECHNOLOGY, Chennai

http://cwet.res.in

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EDITORIAL

C-WET would like to heartily welcome our Hon'ble Minister Shri. Piyush Goyal, Minister of State for Power, Coal and New & Renewable Energy. Also taking pride to welcome our new Chairman of C-WET Dr. Upendra Tripathy, I.A.S., who has joined MNRE as Secretary since April, 2014. We at C-WET are all geared up to face new assignments and pro-active R&D in niche areas of Wind Energy Technology.

C-WET has enabled orderly development of wind power projects in India which is today having a cumulative installed capacity of 21 GW with the energy penetration of about 4%. This is a significant achievement amidst several hurdles of power evacuation, road infrastructure, land availability & cash flow along with policy uncertainties in an infirm wind and solar resource conditions. The removal of Accelerated Depreciation (AD) has strained the wind industry specially the manufacturing sector in India. In the transition of new elected Central Government there are many expectations of this sector which has been facing a recession due to the removal of AD and lack of adequate funds for disbursement of subsidies and other tax incentives due to the wind developers.

During this period, several speed up measures for high quality R&D in the off-grid or grid-tied small wind solar hybrid systems have been taken by MNRE. In addition, several discussions on facilitating the first pilot project of off-shore wind power in India have been initiated with ONGC and the European Union Consortium which has strongly supported India's efforts to go off-shore. After a study of best practices of re-powering of old wind farms in various Countries, a draft re-powering policy has been formulated which is under review at the Ministry. While financing of wind power plants has significantly reduced, the solar energy programme has been steadily attracting more investors due to Government's high priority to the new solar energy sector which has been started rather late in India, inspite of having 300 days of sunshine in most parts of India. One of the significant developments is the German KfW support for the much needed grid evacuation infrastructure for India specially to enable renewable power evacuation from States like Tamil Nadu. At the Ministry there is a move to make big strides in renewable energy by having National character of the Autonomous Bodies attached to the Ministry viz. National Institute of Solar Energy, National Institute of Renewable Energy (proposed to be renamed as National Institute of Bio-Energy) and Small Hydro at IIT, Roorkhee. In line with this, C-WET is likely to be soon renamed as National Institute of Wind Energy Technology (NIWET) with many fold increase in deliverable responsibilities.

C-WET's Research & Development is concentrating on making public the research results of 3 major projects by hosting the e-copies in C-WET's website and about 5 small wind turbines are under testing at Kayathar.

Wind Resource Assessment has been actively doing over 300 MW wind potential technical-evaluation and 20 sites verification apart from maintaining the real-time data acquisition from 100 m mast at 73 locations spread all over India. The wind resource team is also actively progressing with Vortex, Spain to launch wind power forecasting services in India soon. More than three MW class machines have been instrumented for continuous measurements and testing in various sites in India.

Wind Turbine Research Station at Kayathar has been show casing the research wind turbines and the on-going studies to several students & visitors and also working on solarization project with 200 kW old wind turbine.

Standards and Certification has released a renewed certificate for M/s RRB and is actively involved with RLMM and prototype wind turbine commissioning along with discussions with BIS and other new wind turbine certifying bodies.

Information, Training & Community Services division of C-WET has completed an exclusive programme for ASEAN Countries and celebrated for the first time the Global Wind Day with WWF collaboration.

C-WET with an average daily generation of 23,350 kWh (units) of electricity from its research wind turbines at Kayathar has added also about 48 Units of generation from a 15 kW SPV installation which is grid-tied at C-WET, Chennai Campus executed by Engineering Services Division. With the consumption of about 1000 units per day, C-WET energizes itself with green power much more than its consumption.

Our Solar Radiation Resource Assessment has been very active with 119 real-time stations streaming data into C-WET's server apart from four advanced measurement stations commissioned during this period which has aerosol measurements.

C-WET Scientists are engaged internally as well as by invitation to train students and stake holders including SNAs in the areas of wind and solar energy deployment. C-WET re-dedicates itself to serve the Nation with a larger wind & solar mission with your valuable feed backs.

S. Gomathinayagam
Executive Director

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Editorial Board

Research and Development

Testing / Review of documents for Small wind turbine

Small wind turbine testing at WTRS in the wind season 2014 have been started. Presently five models of SWT's are under test. The models under test range from 0.65 kW to 10 kW. Final Duration Test report of one model has been completed. The preparatory works for the 10th meeting of Small Wind Turbine empanelment is underway and the 11th Empanelment list will be published subsequent to the meet.

Publication of Research Reports in website

As a part of serving the larger wind stakeholder community it was decided at C-WET's Research & Development Council that e-copy of research reports of the completed RFP mode projects would be uploaded in C-WET web site for public information. As a start to this initiative the following reports have been uploaded in C-WET's website as '.pdf' downloads;

- Final Report of "Power Evacuation Studies for Grid Integrated Wind Energy Conversion System"
- Final report of "Study on Power Quality Issues in Grid Connected Wind Farms and Identification of Remedial Measures"
- Final report of "Experimental Characteristics of Wind Turbine Blading over full 0 to 360 degree angle of attack".

Wind Resource Assessment

During the period of April to June 2014, 1 new Wind Monitoring Station (WMS) has been established in Karaikal and 4 stations have been closed down (2 in Maharashtra, 1 in Andhra Pradesh & 1 in Jammu & Kashmir). Presently, 154 Wind Monitoring Stations are operational in 15 States and 1 Union Territory under various wind monitoring projects funded by the Ministry of New and Renewable Energy (MNRE) as well as various entrepreneurs.

The following consultancy projects have been completed and reports have been submitted during this period.

- Technical Evaluation for the proposed 308.9 MW wind farm projects.
- Verification of procedure of wind monitoring for 20 sites.
- Indicative Technical Wind Potential for 1 site.
- Pre-feasibility report on establishing proposed wind farm for 1 site.

R&D Projects progress in WRA Unit

- Data acquisition is under progress in the following Wind Monitoring Stations.
  - 80 m Wind Monitoring Station at Ennore Port.
  - 50 m Wind Monitoring Station at Doon University.
- MoU has been signed between C-WET and Gayatri Vidya Parishad – Scientific and Industrial Research Centre (GVP-SIRC) for " Design and Development of a Photonic System for real time remote monitoring of Wind and other Air Parameters".

WRA uncovered/new areas 2010-11

Under the project "WRA uncovered/new areas 2010-11", Installation & Commissioning of 1 no. of 80 m WMS at Karaikal has been carried out and data acquisition is under progress since May 2014.

Estimation and Validation of Wind Power Potential (WPP) at 100 m level in 7 States in India

Wind resource assessment unit had established 73 Wind Monitoring Stations (10 in Andhra Pradesh, 12 in Gujarat, 11 in Rajasthan, 13 in Karnataka, 8 in Maharashtra, 7 in Madhya Pradesh and 12 in Tamil Nadu) under the project on 'Estimation & Validation of Wind Power Potential at 100 m level in 7 States of India and the data acquisition is in progress, continuously monitoring real time wind data received from 73 stations in 7 States. Data analysis, verification and preparation of interim reports are under progress, which will also give daily, hourly & monthly averages.

C-WET/VORTEX, Spain on 'Wind Power Forecasting'

The project is progressing well and is in an advanced stage of launching Wind Power forcasting services in India.

Other Activities

- Mr. A. G. Rangaraj, Scientist had carried out Feasibility Study on Installation of Aero Generator / Wind Solar Hybrid Systems at M/s. Gayatri Vidya Parishad Engineering College, M/s. KC University, M/s. Chaitanya Engineering College, M/s.Godavary Institute of Engineering & Technology and M/s. Gayathri Vidya Parishad College of PG and Degree courses at Andhra Pradesh during 8th to 10th May 2014. Based on the site visit, a report has been prepared and sent to NREDCAP for further necessary action.
- DNV had completed its first periodic audit at WRA unit on 13th June 2014.
- Mr. A. G. Rangaraj, Scientist, Ms. M. C. Lavanya, Scientist & Mr. R. Vinodkumar, Junior Engineer carried out Installation & commissioning of 80 m tall Wind Monitoring Station at Karaikal during 23rd to 26th May 2014.

Wind Turbine Testing

- Measurements for Power Curve Measurements for Garuda 700 kW WT at Melamaruthappapuram Village, (SF. N. 141/5) V. K. Pudur Taluk, Tirunelveli District has been completed.
- Continuous measurements of Inox 2000 kW wind turbine with rotor diameter 100 m at Veraval (Bhadla) village (Survey No.8), Jasdan Taluk, Rajkot District, Gujarat has been completed.
- Continuous measurement of Xyron 1000 kW wind turbine at Richadewda Ratlam District, Madhyapradesh is expected to start during July 2014.
- Continuous measurement of Garuda 1700.84 kW WT with rotor diameter 84 m at Kampaneari Pudhukudi (Village), Tenkasi (Taluka), Tirunelveli District is expected to start during July 2014.
- Continuous measurement for Power Curve Measurements of GWPL 2500 kW WT Vhaspeth, Sangli District, Maharashtra is on-going.
- Site Feasibility Studies for Prototype Testing of PW100 (2.5 MW) WT at Tadiyampatti (Village) in Kalgumalai (Taluka), Thoothukudi Dist, Tamil Nadu is on-going.

Achievement

- The external audit by DNV-GL as per the requirements of ISO/IEC 9001:2008 was completed successfully.

Wind Turbine Research Station

Complete Operation and Maintenance works for 9 numbers of 200 kW MICON make Wind Electric Generators and conditioning of 9 numbers of Transformers of the WEG`s were completed and all the machines are being kept ready for the uninterrupted operation during the windy season 2014.

The following visits were coordinated and showcased the Small & Large Wind Turbine Testing, R&D and WRA facilities:

- Shri. Devarajan Chief Engineer (NCE), TANGEDCO, Chennai along with TNEB officials visited on 28th March 2014.
- 22 participants of 13th International Training Programme on Wind Turbine Technology and Application visited on 23rd May 2014.
- 6 M.Tech students from Periyar Maniyammai College of Engineering, Vallam, Tanjore District, Tamil Nadu visited on 2nd April 2014.

Standards and Certification

- An agreement has been signed with M/s. RRB Energy Limited to take up the project on renewal of Certificate of V 39-500 kW with 47m rotor diameter wind turbine model under Category-II as per TAPS-2000 (amended). Carried out review / verification of documentation in connection with renewal of Certificate of V 39-500 kW with 47 m rotor diameter wind turbine model. Based on the review / verification, renewed Certificate has been issued to M/s. RRB Energy Limited.
- Process of renewal of certificate of Pawan Shakthi – 600 kW wind turbine model is being initiated.
- Review / verification of documentation provided by various wind turbine manufacturers for more than 50 wind turbine models in connection with Revised List of Models and Manufacturers of wind turbines (RLMM) - Addendum-II List have been completed.
- As part of RLMM process, Unit Chief, S&C and S&C Engineer carried out the verification of the new additional manufacturing facility of a wind turbine manufacturer.

Issuing renewed Certificate to M/s. RRB Energy Limited

- Organized the RLMM Committee meeting.
- RLMM Addendum-II List dated 02.06.2014 has been issued.
- Prepared consolidated list of wind turbine models and manufacturers as on June 2014 and hosted the same in C-WET website.
- Based on the request received and documentation submitted, wind turbine Type Certification services of M/s. Intertek Testing Services NA Inc, Cortland, New York, USA and wind turbine Type Testing services of M/s. Intertek Testing Services Shanghai, China are recognized by C-WET.
- Works are being carried out in connection with initiation of next RLMM Main List.
- Review / verification of documentation received for various wind turbine models from wind turbine manufacturers in connection with installation of prototype wind turbines in India as per MNRE guidelines has been completed.
- Organized a Committee meeting on Prototype Wind Turbine Models.
- A letter has been issued in connection with grid synchronization of one prototype wind turbine of "S97-HT DFIG 2.1MW" wind turbine model of M/s. Suzlon Energy Limited.
- Based on the fresh requests received, model specific prototype application forms have been sent to the respective wind turbine manufacturers. Review / verification of documentation / information for the prototype wind turbine models is under progress.
- Co-ordination works with Bureau of Indian Standards (BIS) in connection with standards related activities are ongoing.
- S&C unit had successfully undergone the first periodic audit conducted by Det Norske Veritas as per ISO 9001:2008. Continual improvement and maintaining the Quality Management System are ongoing.

Information, Training and Community Services

13th International Training Programme

The ITCS Unit had successfully organized the 13th International Training Programme on "Wind Turbine Technology and Applications" during 7th – 30th May 2014 specially for Association of South East Asian Nations (ASEAN) countries at C-WET, Chennai, which was sponsored by Ministry of External Affairs (MEA), Government of India under the ASEAN-India Cooperation Fund programme and supported by Ministry of New and Renewable Energy, Government of India. The course was attended by 22 participants from 8 countries (Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand, Vietnam).

The training was inaugurated by Dr. Yogender Kumar Yadav, Director, Sardar Swaran Singh – National Institute of Renewable Energy, Kapurthala, Punjab.

Dr. Yogender Kumar Yadav inaugurating the training

Forty Eight lectures were scheduled during 23 days programme, which was handled by 18 C-WET scientists, 5 manufacturers, 6 developers, 2 consultants and 4 premier academicians. Apart from theoretical lectures, we had scheduled practical classes to Wind Resource Assessment Laboratory, Small & Large wind turbine testing and R&D facilities. To provide hands an experience, visits to Large Wind Turbine Manufacturing Factory (M/s. Gamesa Wind

Participants at Gamesa & Vaata Manufacturing factory

Turbine Pvt. Ltd., Mamandur) and Small Wind Turbine Manufacturing Factory (M/s. VAATA Infra Ltd, Red Hills) were also arranged.

Participation in the Exhibitions

ITCS unit had established and managed C-WET Stall in the following Exhibitions. Created awareness and shared knowledge about C-WET activities & services to the visitors in various capacities.

* "Green Summit 2014" organized FKCCI at Bangalore during 5th to 7th June 2014.
* "Renergy 2014" organized by Tamil Nadu Energy Development Agency (TEDA) during 12th to 14th June 2014 at Chennai Trade Centre, Chennai.

GLOBAL WIND DAY 2014 (C-WET - WWF Collaboration)

Since 2007, the Global Wind Day has been celebrated on 15th June to create awareness about the advantages and achievements of wind power. Since 2009, C-WET is celebrating the Day with various events among the School Children. To proactively reach the future kids, C-WET this year signed an MoU with World Wide Fund for Nature (WWF) – India.

On the eve of Global Wind Day C-WET - WWF jointly engaged over 100 School Children from various parts of the State at C-WET campus and shared basic knowledge about wind and renewable energy. As part of the celebration, Drawing and Elocution competitions on Wind Energy were conducted for the children and prizes were distributed to the winners.

Dr. Malleshappa, IFS, Director Environment, Department of Environment, Government of Tamil Nadu was the Chief Guest and delivered special address to the students and their teachers. To create awareness in a bigger level, a book "Student Guide on Renewable Energy" was prepared and released on the same day with lot of information about renewable energy including games that induce children to think on the Renewable energy. The Student Guide will be translated in different languages and distributed in larger community.

Glimses of Global Wind Day Celebtration

Engineering Services Division

- Work order has been released for installation of the CCTV camera at C-WET campus.The materials have been received and work of installation and commissioning is under progress.
- The National Informatics Centre's (NIC) e-mail facility has been extended to all C-WET regular staff.

15kW SPV Power Plant

C-WET's 15 kW off-grid SPV power plant which earlier was charging a Battery Bank, was converted into a grid tied system and put-in operation since 11th June 2014. This activity taken up by the 'ESD' has generated good knowledge in such conversion process where in batteries are no more a requirement and saves a lot of capital revenue for the user department towards battery replacement, which is a recurring expenditure.

The current grid tied system is connected on the LT side of the C-WET electrical network and is generating about 48 kWh per day maximum. C-WET consumes about 1000 kWh per day and solar generation even though is small will go a long way in making such grid tied systems profitable. This is the significant step forward in energy self reliance inside C-WET, with incremental SPV too, in addition to our captive average daily generation 23000 kW from research wind turbines at Kayathar.

15 kW on grid SPV power project

INTERNATIONAL TRAINING ANNOUNCEMENT

12th International Training Programme on

"WIND TURBINE TECHNOLOGY AND APPLICATIONS"

Specially for African Countries

during 19th November - 12th December 2014

Detailed information is made available in C-WET websites

Solar Radiation Resource Assessment

- All the 4 Advanced Measurement stations, one each at NISE - Gurgaon, Prathyusha Institute of Technology and Management (PITAM) - Chennai, PDPU - Gandhinagar, IIEST - Kolkata, are completed and commissioned.
- All 60 SRRA stations proposed in Phase II SRRA project were completed and commissioned.
- 4 MEDA SRRA stations were completed and commissioned in the State of Maharashtra under consultancy project.
- The works for establishing Calibration Lab at C-WET, Chennai has been completed and another Lab is proposed in PITAM, is also operational now.
- Calibration of solar sensors from Vellore, Trichy, Karaikudi SRRA stations have been completed and re-installed.
- Calibration of pyranometer and pyrheliometer received from M/s. SGS Weather and Environmental Systems Private Ltd. under consultancy mode.
- The procurement of satellite data after global tenders has been completed and Solar Atlas for the country will be completed within next 6 months.

Training Program Conducted by SRRA:

The following training programmes have been successfully organized by the SRRA Unit enable to maintain and manage the SRRA measurement stations effectively for the benefit of SRRA station in-charge.

- "Importance of Measurement of Ground Solar Radiation Data in the Penetration of Solar Energy" for SNA officials in the North East region at Guwahati on 8th May 2014.
- Jointly with NISE, Gurgaon on 'Functioning and Maintenance of SRRA stations' for phase-II SRRA stations i/c's at NISE, Gurgaon during 2nd to 3rd June 2014.
- Jointly with PITAM, Chennai on 'Functioning and Maintenance of SRRA stations' for phase-II SRRA stations i/c's at PITAM, Thiruvallur during 19th to 20th June 2014.
- Jointly with MGIRI, Wardha on 'Functioning and Maintenance of SRRA stations' for phase-II SRRA stations i/c's at Wardha, Maharashtra during 23rd to 24th June 2014.

Invited lecture delivered / meeting attended by C-WET Scientists in external forums

Dr. S. Gomathinayagam, Executive Director

- Chaired Prototype Meeting at C-WET on 3rd April 2014.
- Attended Operational Review Meeting at MNRE on 9th April 2014.
- Participated in the Inauguration of IGCS Research Programme for Sustainable Power Engineering at IIT Madras on 11th April 2014.
- Attended 2nd Review Meeting of MNRE R&D Proposals at C-WET on 15th April 2014.
- Visited M/s.Vaata Infra Ltd., Factory at Red Hills regarding R&D of a new vertical axis small wind turbine May 2014.
- Attended Workshop on Forecasting, Balancing & Scheduling of Renewable Energy Sources in India organized by IGEF at New Delhi on 5th and 6th May 2014.
- Chief Guest for Technology day of IGCAR, DAE Kalpakkam Township on 9th May 2014.
- Attended GBI consultative Meeting at MNRE New Delhi on 20th May 2014.
- Attended Management Review Meeting at C-WET on 21st May 2014.
- Attended the 500 W Wind-Solar Hybrid Product Launch of NAL, Bangalore and gave Key Note address on Renewable Energy Initiatives on 23rd May 2014.
- Attended Meeting in MNRE to discuss about MOA, Bye-law, name change of C-WET on 28th May 2014.
- Attended as a Chairman of the RDSPAC- R&D Sectoral Project Appraisal Committee Meeting at MNRE on 5th June 2014.
- Participated in Conference of States' Principal Secretaries/Secretaries dealing with Renewable Energy and the Heads of SNAs for Renewable Energy on 10th June 2014.
- Participated in Panel discussions at RENERGY 2014 Conference at Chennai Trade Centre conducted by TEDA from 12th -14th and Chaired the Session on "Towards 50 GW of Installed Wind Capacity – Opportunities And Challenges" on 12th June 2014.
- Inaugurated 2 days Training Programme on "Functioning and Maintenance of SRRA Stations" at Prathyusha Institute of Technology and Management, Tiruvallur, Tamil Nadu on 19th June 2014.

Deepa Kurup

- Delivered a presentation on "Wind and Solar Energy - Potential & Challenges" at one day seminar on

"Exploring the current issues and challenges in sustainable energy" at IIT, Madras on 5th June 2014.

K. Boopathi

- Attended the Pre-Bid meeting for Consultancy Services for the proposed 50 MW wind farm projects in Maharashtra / Tamil Nadu / Andhra Pradesh for M/s.NHPC during 15th - 16th April 2014.
- Attended Wind Forecasting meeting at MNRE, New Delhi during 5th & 6th May 2014.
- Attended meeting of the Sub Group 2 on "Renewable Energies" under the framework of the Indo German Energy Forum at New Delhi on 7th May 2014.
- Attended Offshore Review meeting at Ahmedabad, Gujarat on 13th May 2014.
- Attended 61st Annual General Body Meeting & National Seminar on "Energy Planning for the Sustainable Development of Kerala" organized by KSEB Engineers' Association on 1st June 2014.

M.Joel Franklin Asaria

- Attended Project Monitoring Committee meeting constituted by Government of Kerala for setting of Wind Power Projects in Kerala for M/s.NHPC on 7th May 2014.

B. Krishnan

- Attended Project Monitoring Committee meeting constituted by Govt. of Kerala for setting of Wind Power Projects in Kerala for M/s. NHPC on 7th May 2014.

S.A. Mathew

- Participate in the Industry Institute Interaction with National Board of Accreditation (NBA) committee at Veltech Dr. RR & Dr. SR Technical University, Chennai on 3rd May 2014.
- Chaired R&D Meeting (Electrical & Electronics Engineering) where professors presented their innovative research proposals at Veltech Dr. RR & Dr. SR Technical University, Chennai on 25th May 2014.

P. Kanagavel

- Attended meeting with MNRE & UN-ESCAP officials on ESCAP Phase-II Expert Group meeting at MNRE, New Delhi on 11th April 2014.
- As Chief Guest inaugurated the "ICSECSRE – 2014, - First International Conference" organized by the Department of Electronics and Communication Engineering of Arupadai Veedu Institute of Technology, Chennai, Vinayaka Miassion University on 28th April 2014.
- Delivered Keynote address and inaugurated the National Conference on Innovative & Emerging Trends in Engineering and Technology (NCIETET' 14) organized by the Panimalar Institute of Technology on 6th May 2014.
- As Chief Guest Inaugurated the Faculty Development Programme on "Application of Soft Computing Methodologies for Innovations in Electricity Markets" organized by SRM University, Ramapuram, Chennai on 23rd June 2014.

C.Stephen Jeremias

- Lecture delivered on "Information Technology Security" for the TTT programme at C-WET on 3rd April 2014.

G.Giridhar

- Attended the Indo-German Energy Forum meeting at New Delhi during 5th & 6th May 2014.
- Delivered a lecture on "Conceptualizing Framework for Solar Resource Data in India" at Federation of Indian Chambers of Commerce and Industry (FICCI), New Delhi on 29th May 2014.

Sasikumar

- Lecture delivered on "Solar Radiation Resource Assessment in India" in the 2 day training program on "Functioning and Maintenance of SRRA stations" at NISE, Gurgaon on 2nd June 2014.

Prasun Kumar Das

- Delivered a lecture on "Basics of Solar Radiation" in the training program on "Importance of Measurement of Ground Solar Radiation Data in the Penetration of Solar Energy" at Guwahati on 8th May 2014.
- Attended a meeting on NREL projects in India with scientists from NREL and NISE at NISE, Gurgaon on 30th April 2014.

Visits Abroad

K.Boopathi attended the Offshore Wind Energy Review meeting organized by British High Commission at London held during 9th & 10th June 2014.

K.Boopathi participated in the 13th Annual Offshore Wind Energy (GOW14) Conference organized by M/s. Renewable UK (formerly BWEA) at Glasgow, United Kingdom held during 11th & 12th June 2014.

S.A. Mathew participated in the IEC CAC Advisory Group for Test Laboratories meeting at Westin Poinsett, Greenville, South Carolina, USA held during 12th and 13th of May, 2014.

Dr. G. Giridhar visited U.S. for training/FAT for AMS at Yankee Instruments, Massachussetts, USA under phase II during 5th to 14th April 2014.

The following C-WET staff delivered lecture(s) in the 13th International Training Programme on "Wind Turbine Technology & Applications" held during 7th to 30th May 2014 specially for ASEAN countries

S.No.	Topic	Speaker
1	• Introduction and Status of Wind Energy Technology • Wind Turbine Tower	Dr. S. Gomathinayagam
2	• Wind Resource Assessment and Techniques • Wind Resource Assessment by Remote Sensing Instruments	Shri. K. Boopathi
3	• Wind Energy Development in India • Role of C-WET in Wind Energy Development • Environmental Aspects of Wind Turbine Technology	Shri. P. Kanagavel
4	• Guidelines for Wind Measurements • Wind Measurement and Instrumentation	Shri. B. Krishnan
5	• Wind Data Measurements and Analysis	Smt. G. Arivukkodi
6	• Overview of Wind Turbine Components • Drive Train Concepts	Shri. J. C. David Solomon
7	• Wind Turbine Gear Box	Shri. N. Raj Kumar
8	• Wind Turbine Generators	Shri. M. Anvar Ali
9	• Control and Protection System in Wind Turbine	Shri. S. Arulselvan
10	• Wind Turbine Foundation • Small Wind Turbine Testing and Hybrid Systems	Shri. Rajesh Katyal
11	• Grid Integration of Wind Turbine	Smt. Deepa Kurup
12	• Type Certification of wind turbine and overview of Design Requirements as per IEC 61400 - 1	Shri. A. Senthilkumar
13	• Wind Turbine Testing & Measurement Techniques • Power Curve Measurements	Shri. S. A. Mathew
14	• Instrumentation for Wind Turbine Testing	Shri. M. Saravanan
15	• Safety and Function Testing	Shri. Bhukya Ram Das
16	• Offshore Wind Energy: An Overview	Shri. Joel Franklin Asaria
17	• Indian Government Policies, Schemes and Legal Frameworks	Shri. Mohammed Hussain
18	• Solar Energy and Solar Radiation Resource Assessment	Dr. G. Giridhar

NATIONAL TRAINING ANNOUNCEMENT

16th National Training Course on "WIND ENERGY TECHNOLOGY" during 23rd - 25th July 2014

17th National Training Course on "WIND ENERGY TECHNOLOGY" during 29th - 31st October 2014

Detailed information is made available in C-WET websites.

Training / Conferences / Seminars attended by C-WET Scientists

J.C. David Solomon

- Attended training on E-procurement at C-WET during 7th & 8th April 2014.

K. Boopathi

- Attended training on E-procurement at C-WET during 7th & 8th April 2014.

M.Joel Franklin Asaria

- Attended "Green Summit 2014" at Bangalore during 5th to 7th June 2014.

A.G.Rangaraj

- Attended training on E-procurement at C-WET during 7th & 8th April 2014.
- Attended MATLAB training at Prathyusha Institute of Technology and Management (PITEM), Tiruvallur during 21st to 23rd April 2014

M.C.Lavanya

- Attended MATLAB training at Prathyusha Institute of Technology and Management (PITEM), Tiruvallur during 21st to 23rd April 2014

S.A.Mathew

- Attended the ISO 9001-2008 - Seventeenth Management Review Meeting of Quality Management System at C-WET on 21st May, 2014.
- Attended the DNV First periodic Audit – ISO 9001:2008 at WTTS, Kayathar on 12th June, 2014 and at C-WET 13th June 2014.

P. Kanagavel

- Attended "Green Summit 2014" at Bangalore during 5th to 7th June 2014.

M.Saravanan, Bhukya Ramdas, S.Paramasivan

- Attended the ISO 9001-2008 - Seventeenth Management Review Meeting of Quality Management System at C-WET on 21st May, 2014.
- Attended the DNV First periodic Audit – ISO 9001:2008 at WTTS, Kayathar on 12th June, 2014 and at C-WET 13th June 2014.

Testing Unit Staffs

- Attended training on Power Curve Data analysis (Data appending, Data binning, Pivot table, AEP calculation) and GNU plot organized by A.R. Hasan Ali, AE on 10th June 2014.

M.Anvar Ali

- Attended the Training on E-Procurement at C-WET on 7th & 8th April 2014.

C.Stephen Jeremias

- Attended the Technical Workshop for Metasploit and Nexpose at Bangalore on 30th April 2014.

Training on RFD

Finance and Administration of C-WET has organized a training on Research Framework Document (RFD) through Institute of Secretariat Training and Management (ISTM), Department of Personnel & Training, New Delhi, Government of India during 25th - 26th April 2014 successfully. All C-WET staff and staff from neighbouring Government institutions attended the training.

RENERGY - 2014

A. Senthilkumar, M. Anvar Ali, P. Kanagavel, M. Joel Franklin Asaria, J.C. David Solomon, Prasun Kumar Das, R. Karthik, A.G. Rangaraj, J. Bastin, M.C. Lavanya & N. Raj Kumar attended the International conference on "RENERGY - 2014" organized by TEDA at Chennai Trade Centre, Chennai during 12th to 14th June 2014.

INTERNATIONAL TRAINING ANNOUNCEMENT

14th International Training Programme on

"WIND TURBINE TECHNOLOGY AND APPLICATIONS"

during 3rd - 30th September 2014

15th International Training Programme on

"WIND TURBINE TECHNOLOGY AND APPLICATIONS"

during 4th February - 3rd March 2015

Detailed information is made available in C-WET websites

WIND POWER FORECASTING FOR INDIA

K. Boopathi, Unit Chief, Wind Resource Assessment, Centre for Wind Energy Technology, Chennai
Jordi Ferror, Managing Director, VORTEX, Spain
S. Gomathinayagam, Executive Director, Centre for Wind Energy Technology, Chennai

Introduction

Due to ever increasing prices of fossil fuels, with an increasing demand for electricity and enhanced concerns about greenhouse gas (GHG) emissions, wind power, as a renewable and clean source of energy, is rapidly being introduced into the existing electricity mix in India. The rapid increase in the penetration of wind power into power systems introduces more variability and uncertainty in the electricity generation mix, and these factors are the key challenges when it comes to integrating wind power into the electric power grid. Wind power forecasting (WPF) is an important tool to effectively address this challenge, and significant strides have been made in developing more accurate wind power forecasts.

In India, wind power production forecasting has already been started. There are many service providers providing wind power forecasting services for different terrain conditions using different forecasting methods. In order to start wind power forecasting services to the wind industry, Centre for Wind Energy Technology (C-WET) has already initiated wind power forecasting projects in association with RISO, DTU, Denmark and Vortex, Spain. Under the Indo-Spanish Joint Programme (Vortex) for Technological Co-operation in Renewable Energy with the objective to propose a holistic approach for forecasting wind and wind power from an installed capacity of more than 7000 MW of wind energy in Tamilnadu as the ultimate deliverable to support the scheduling and dispatching process of electricity from these wind farms.

Central Electricity Regulatory Commission has made an amendment that all the wind power developers have to predict how much they will generate during each 15 minute interval the following day for those wind farms built in 2011 or later, with an installed capacity greater than 10 MW, are mandated to forecast their production. The wind generators/wind farm owners shall be responsible for forecasting their generation up to an accuracy of 70%. Therefore, if the actual generation is beyond +/- 30% of the schedule, wind generator would have to bear the Unscheduled Interchange (UI) charges. For actual generation within +/- 30% of the schedule, no UI charges would be payable/receivable by Generator. Though the amendment has been withdrawn, still customers, the state distribution company wants wind power forecasting service in order to manage grid properly and effectively. Wind power can be predicted in different methods. The methods are as follows

- **The Wind Power Forecasting Methods**

The most common wind power forecasting methods are

- **Persistence Method:** which assumes the wind speed at time $t+\Delta t$ will be same as the wind speed at time t.
- **Physical Approach:** which use parameterization based on the detailed physical description of the atmosphere, usually wind speed given by a weather service on a coarse grid is transformed to the onsite conditions at the location of the wind farm. Numerical Weather Prediction is a Physical Approach to wind power forecasting.
- **Statistical Approach:** Statistical Approach is based on training with measurement data and uses difference between the predicted and actual wind speeds in immediate past to tune the model parameters. There are two types of statistical approaches. They are: Time series based models and neural network based models.

- **Hybrid Approach:** The combination of different approaches such as mixing physical and statistical approaches or combining short term and medium term models, etc. is referred to as a Hybrid Approach.

Prediktor model forecasting-RISO, DTU Denmark:

C-WET has been using a commercial wind power forecasting tool named Prediktor which was developed by Riso National Laboratory, Denmark. In this system large scale flow is simulated by a Numerical Weather Prediction (NWP) model. The system's main idea is to use the wind speed and direction from a NWP, then to use power curve of Wind Turbine Generator (WTG), transform these variables to the local site and finally use the power curve including the wake effects. A statistical improvement module Model Output Statistics (MOS) can either set in before the transformation to the local wind or before the transformation to power or at the end of the model chain trying to change the power. A combination of all these is also possible.

Data Used

Global Forecast system (GFS) forecast data has been used to forecast the weather variables which have to be given as the input to the Prediktor. This data is being initialized every 12 hours (twice a day) and gives forecast every 3 hours with a horizontal spatial resolution of 0.5 degree (around 55 km) grid throughout the globe. Its temporal resolution is 65 forecasting in 8 days with data available at 26 vertical levels from 1000 mb to 10 mb pressure levels. This data contains 154 weather variables. Wind Atlas Analysis and Application Programme (WAsP) compatible matrix file has been used to incorporate the orographic features. For the present study the data has been downloaded for a single point in which the reference turbine is located. Wind speed and direction data at the required hub height of the wind turbine have been derived to forecast the weather variables.

Figure 1. Shows the GFS forecasts for the position 19.11N, 74.60E for 10 m above ground level. The different colours are different forecast runs. The data comes every 12 hours (at 00 and 12 UTC), for a forecast horizon between 0 and 196 hours, with a time step of 3 hours. The Figure 2 shows the comparison of measured and predicted power. The graph depicts the predicted power is lower than actual power. This has been discussed with RISO and they have advised to use National Centre for Medium Range Weather Forecasting (NCMRWF) data.

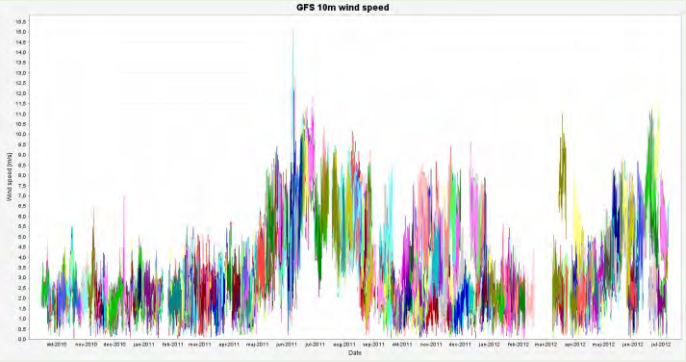

Figure 1: The GFS forecasts for the Khandke position for 10m a.g.l. Every forecast is 196 hours long and presented in its own colour. There is a new forecast every 12 hours.

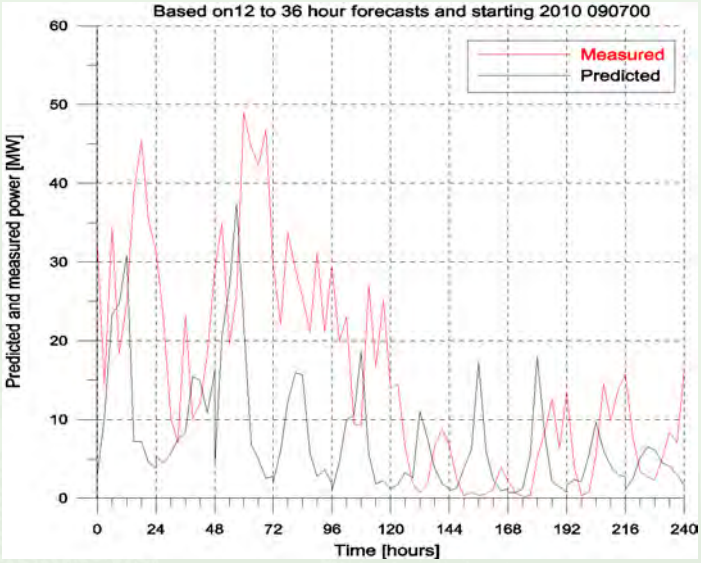

Figure 2. 10 days predicted and measured power, predictions based on 12 to 36 hour GFS forecasts. Time 0 equals 2010, 07 September, 00 UTC

Error Calculation For Different Months

Error calculation has been carried out using the monthly average values of three hourly data given by predictor and observation data for windy (May– June) and non-windy months (December – April) using the

available measured data. It was observed that for the windy months the error values (MAE 13-18% & RMSE 16-20%)) are higher than that of non-windy months (MAE 5-7% & RMSE 9-10%). When we do error analysis Normalized with installed capacity of wind farms the MAE increases from 25 -35% and RMSE increases 32 - 40%. Figure 3. shows the errors between the wind power prediction and calculated power values from the actual energy generation data.

Figure 4. shows the overall wind power generation error (% of capacity of the wind farm) during November 2010. The power accuracy assessment shows that the RMSE of power throughout the range of forecast is between 10% and 18% of the wind farm capacity and the mean absolute error of power varies between 6% and 12 % of the wind farm capacity.

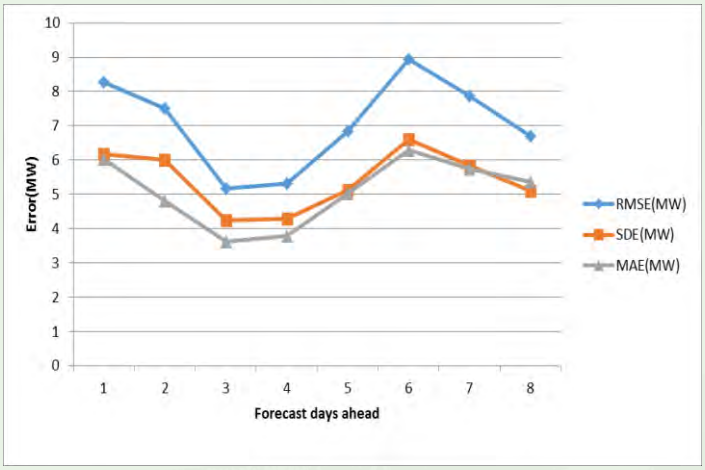

Figure 3: The wind power errors for the month of November 2010 at Khanke

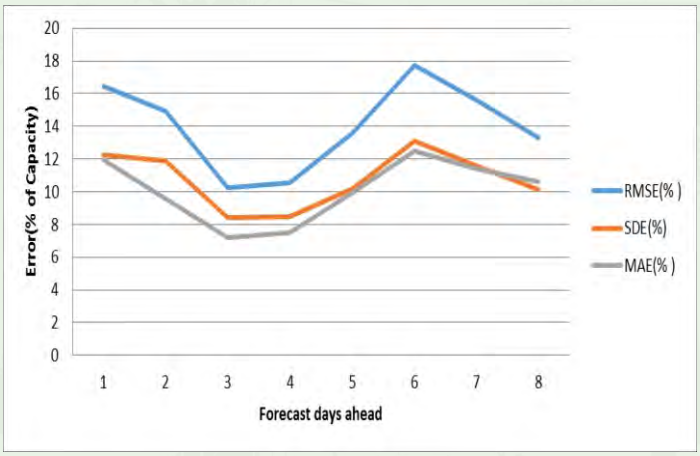

Figure 4: Overall power error (%) for the full range of forecast days in November 2010 Khandke

Future Improvements to 'Prediktor Model'

In order to enhance the reliability of Wind Power Forecasting by reducing the error levels C-WET has collaboration with NCMRWF to have access to India specific remote sensing data and to continue the work with RISO.

VORTEX Model - Spain

Wind and Power Forecast Services

Under Indo-Spanish Joint Programme for Technological Co-operation in Renewable Energy, MNRE/C-WET had signed MOU with VORTEX FACTORIA DE CÀLCUL SL, Spain for, Forecasting of wind and wind power for the purpose of scheduling and dispatching of electricity from wind turbine generators in Tamilnadu, India.

C-WET and VORTEX have developed a new Forecasting service for the wind industry focusing its efforts on two main aspects: highly accurate results and highly customizable service. C-WET is aware of the several wind industry needs of forecasting services depending on both the final user profile as well as the electricity market characteristics for each country. By taking very much into account the referred wide range of customers, needing forecast services, C-WET would like to offer wind/wind power forecasting services soon by end of 2014. From the technical point of view, VORTEX has already developed a Forecasting system by combining the most recent and innovative numerical tools and modern state of the art framework which can be easily adapted to the fast-changing and demanding needs of wind energy industry.

C-WET/VORTEX uses a mixture of physical and statistical schemes

As latest state of the art forecasting technologies, C-WET/VORTEX uses a mixture of physical and statistical approaches. C-WET/VORTEX generates forecast information by calibrating physical input from global and mesoscale numerical weather prediction models against historical wind farm observations (real or synthetic) with the use of advanced statistical

techniques. The obtained calibration is used as learning information which can then be used to project to the future and thus generate forecasted information.

From the physical point of view, C-WET/VORTEX makes use of several global numerical weather prediction atmospheric models, among which the European Center of Weather for Medium Range (ECMWF) forecasting deterministic model and the North American Global Forecasting System (GFS) constitute the two main inputs or National Centre for Medium Range Weather Forecasting (NCMRWF) in India. Both models are used on an operative basis and have been intensively validated. Besides the global models, C-WET/VORTEX makes use of the WRF model in order to generate in-house mesoscale data that is also input to our forecasting system. In relation to the use of mesoscale, C-WET/VORTEX has demonstrated high competitive skills for the last years by being one of the most used services in Wind Resource Departments worldwide.

The combination of both global and mesoscale data provides a detailed description of the wind and other meteorological variables from the synoptic to the local scales that will determine the quality of the forecast service. That is a better knowledge of the climatology of the site as well as a global and homogeneous approach in terms of continents and regions.

A multi scheme framework

The statistical forecasting system is a multi-scheme framework: several statistical strategies are implemented by combining different classification and non-linear regression models, among which methods such as machine learning, clustering or pattern recognition are used. The main reason for using several statistical techniques is the fact that each of the methodologies shows different sensitivities and thus different performance as a function of the quality, quantity and availability of measured data. In other words, each methodology has different skills when reproducing specific patterns or behaviours of the wind farm. The system is configured so that it is able to detect which of the methodologies should be used under each situation and thus optimize the accuracy. The mentioned statistical system can then be considered as a time adaptive framework since it is able to change it's computing priorities depending on each reality.

If real time data are available for last past few hours, the system makes use of auto-regressive methods which are purely based on observations persistence instead of using NWP data from the models in order to generate the first 6 or 10 hours of the forecasts. Similarly, the system configuration is quite particular for each of the ahead ranges. A different training information is used when projecting the first 24 hours of the forecast than those hours between 24 and 48 hours ahead. This allows to correct the bias or degradation of the model performance when increasing the ahead time, which is something quite intrinsic to the numerical weather prediction due to the lack of consistent boundary and initial conditions.

The above described scheme generates a group or ensemble of single forecasts resulting from combining several statistical techniques with the different numerical weather prediction inputs. Each of the group members is combined and weighted in a clever manner as a function of each of the members performance depending on the observed wind farms patterns.

A Bayesian ensemble technique is used for computing this ensemble selection so that a deterministic forecast is generated for each of the requested variables by the users such as Power, Wind Speed, Wind Direction, Temperature, Pressure or Density. Similarly, information of the 10% and 90% percentiles is computed and added to the forecasts.

Highly accurate service at a very attractive price

The Forecast system has been extensively validated under significantly different climatic and topographic conditions and under very different availability of observations and real time data. The forecasting

system accuracy is comprised between 8-17% in mean absolute error with respect to the wind farm Power (MAE) when referring to 24 hours ahead forecasts and given a minimum of standard conditions such as at least 9 month of available observations and no Real time data updates. However, the variability of the accuracy is really dependent on the wind Farm as well as on the good quality of the input data. Turbine availability information might be crucial in this sense. Furthermore, the determination of each wind farm accuracy will also depend on the market characteristics and the user expectations. Results obtained against other forecast providers show that C-WET service (Fig.5) is highly competitive in terms of accuracy. C-WET offers a fast, reliable and highly accurate service at a very attractive price. The characteristic details of the forecast is given in the Table 1.

Test results

C-WET has received generation data from one of the customers and the same site/data was used for forecasting using Vortex model (July 2013 to April 2014). The test results are given below

The accuracy results for the whole period are the following:

MAE to observations: 24.2% error

MAE to rated power: 17% error

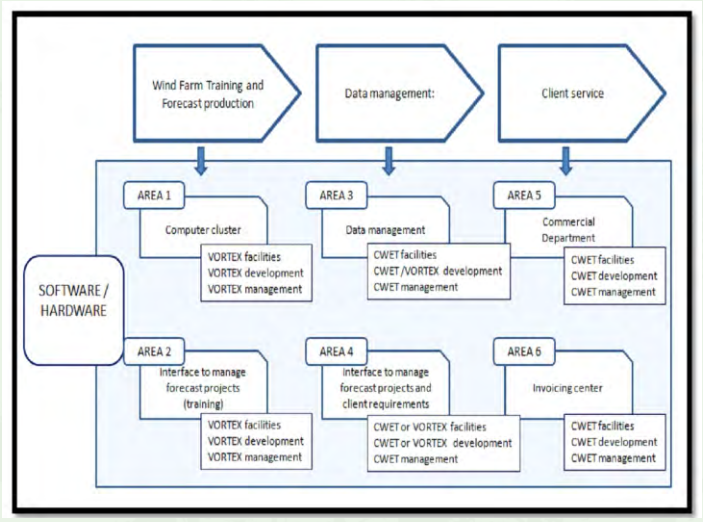

Fig 5.The detailed structure of forecasting system

The Figure 6 shows the actual forecasting data and 7 shows the comparison between actual and forecasted data.

Fig 6. Forecasting results for the 50 MW wind farm

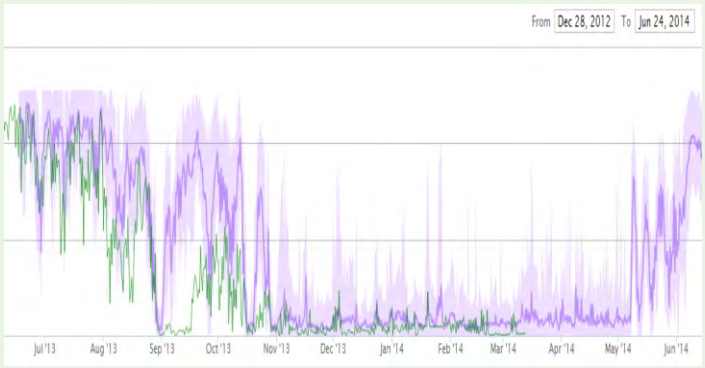

Fig 7. Comparison of forecasting results with actual generation

Green line- real data production

Blue line- power forecast

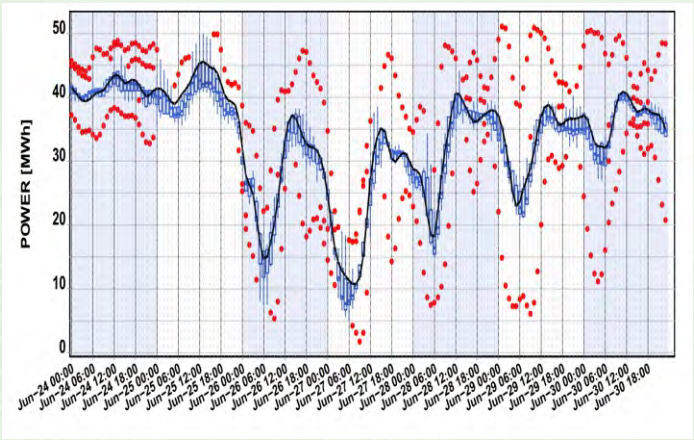

Fig 8. Seven days ahead forecasting graph

The errors are high during these period introduced mainly because of period of September where the data provided and the forecast seems to be quite different. This is because those duration the availability of wind turbines are less due to grid failure.

Table 1. Technical characteristics of the forecasting.

Main Technical characteristics: Variables	Power production, Wind speed & direction, Temperature Pressure, Density
Horizon	Up to 10-days ahead
Granularity	(Sub) hourly
Daily Updates	Upon client request By default: 2 (1 every 12 hours)
Data delivery	Upon client request Available options: (S)FTP, DDBB & email
Forecast delivery	Upon client request Available options: (S)FTP, e-mail Web Interface, DDBB

Conclusion

Wind power forecasting is an important tool to improve the efficiency and reliability of power systems with a large penetration of wind power. C-WET/VORTEX are currently working to provide forecasting services to the wind industry for every 15 minutes forecast up to 10 days ahead. As per the test run with one of the wind farm, the MAE of 8-18% was observed. C-WET will offer a fast, reliable and highly accurate service at a very attractive price. The service will be started soon in 2014.

References

- Mathias Lange, Ulrich Focken ,"Physical Approach to Short Term Wind Farm Production in Complex Terrain , Springer 2005.
- Brandon Mauch, "Prediction of variability" , Carnegie Mellon University
- Gregor Giebel,"The state of the Art in Short Term Prediction of Wind Power A literature Overview"2003
- Short Term forecasting Fact Sheet for Prediktor, Riso National Laboratory, 2006.

PROMOTION

Name	Cadre from	Cadre to	Department
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K. Boopathi	Scientist 'C' & Unit Chief i/c	Scientist 'D' & Unit Chief	WRA
N. Rajkumar	Scientist 'B'	Scientist 'C'	S&C
B. Muthulakshmi	Sr. Steno	Sr. Personal Assistant	F&A
M.R. Gunasekaran	Sr. Steno	Sr. Personal Assistant	R&D
C. Stephen Jeremias	Junior Engineer	Assistant Engineer	ESD
T. Suresh Kumar	Junior Engineer	Assistant Engineer	WRA
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R. Naveen Muthu	Technician	Junior Engineer	R&D
R. Vinod Kumar	Technician	Junior Engineer	WRA

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