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A Newsletter from CENTRE FOR WIND ENERGY TECHNOLOGY, Chennai

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EDITORIAL

"Give me what I want- When I want" would be the future slogan for electric power supply. With hybridization and solarization of wind power (single wind turbine – Small, Big or wind farm as a whole) the wind energy sector is certainly bound to increase the CUF (Capacity Utilization Factor) much beyond the National average of 20% level. With developed countries such as USA, Europe and UK going in for off-grid/micro-grid community wind turbines which are in the range of capacities 100 kW to 500 kW, in India there is a vast scope of using the sub-mega watt wind turbine in any potential location in India where either grid connectivity is poor or the power cuts are long. Proven technologies do exist for desalination of brackish water to potable drinking water using wind turbines or wind solar hybrids. Excess renewable power if the load demand is less can be pumped into a sales grid for charging electrically operated vehicles or devices at a reduced unit cost of electricity. It also saves considerable fossil fuel if it is utilized by a significant fraction of our billion population.

Roof top wind solar hybrids have already proved to be cost competitive with net metering utilized providing adequate distributed generation of power by individual consumers. If many urban affordable population resort to these small wind energy systems (with or without solar) the load on central generation plants can be significantly reduced or the power so released can be used for providing power for the needy reducing their power cuts. Solarization has already been demonstrated as an integrated wind solar system by M/s. ReGen Power Tech Private Limited in two sites in India by appropriate special design of their power conversion modules in megawatt class machines. This is a welcome feature since most of the wind turbines in India operate most of the duration with less than their rated capacities. The residual capacity up to the rated capacity can be very well utilized during the day with solarization without even using energy storage modules. The proof of concept demonstrated with such wind solar hybrid in single wind turbine or in wind farms would require no additional transmission and power evacuation infrastructure up to the rated capacity of the system. There is a need for research to create certification standards and cost reduction.

Reverting back to C-WET activities during this quarter R&D Unit has been busy with Small Wind Turbine Testing with two new wind turbines erected at Kayathar including a first ever vertical axis turbine. One more new project involving a novel hybrid energy system has been initiated in collaboration with NIT, Tiruchirapalli. WRA Unit has been quite busy in completing a 100 m anemometry project at 75 locations all over India. Steadily there has been an increase in training programmes at C-WET specially for the State Nodal Agencies. The first ever comprehensive programme on Wind Resource Assessment for State Nodal Officers has significantly improved the understanding and co-operation in completing the National Resource Assessment programmes in Wind and Solar. The Testing Unit of C-WET has signed two agreements during this period. WTRS Unit has been co-ordinating the 120 m met mast erection at Kayathar as well as the technical visits of course participants. S&C Unit has been reviewing several documentation of over 45 models for the main list of RLMM and also signed for renewal of Certification of RRB 600 kW machine. ITCS Unit completed 11th International training programme which included hands on training for manufacturing small wind turbines at MinVayu facilities at Auroville. There was a knowledge forum lecture by UL-DEWI during the period and there were several student visitors from Engineering Colleges. Solar Radiation Resource Assessment Unit has initiated random inspection of sites for finalizing the Phase II Stations during the period. Scientists were also quite busy sharing their knowledge through invited lectures and conference participations and in Exhibitions. OEM training was under taken by few scientists on solar equipment calibration at Madrid Spain and invited lecture was delivered in China by a Scientist in energy forum. I place on record my sincere thanks to Energy and Environment Foundation who organized the 4th World Renewable Energy Technology Conference and Exhibition and the Team C-WET for enabling me the "Global Excellence Award-2013 in Renewable Energy" during September 2013 at New Delhi.

We would like to invite your constructive criticism to serve you better.

S. Gomathinayagam
Executive Director

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Editorial Board

Developments in R&D UNIT

Small Wind Turbine Testing

Presently two testing agreements were signed, one with M/s. Spitzen Energy Private Limited and another with M/s. Sunair Power for testing of their Small Wind Turbine Models at Wind Turbine Research Station (WTRS), Kayathar. The Horizontal Axis Small Wind Turbine (HAWT) of M/s. Spitzen Energy Private Limited has been installed and commissioned and the testing is underway. While the small wind turbine of M/s. Sunair Power is a Vertical Axis Wind Turbine (VAWT) and is first of its kind to be tested by C-WET. The installation and commissioning of the turbine is in progress. With this, R&D unit is presently testing 10 small wind turbine models ranging from 3.2 kW to 10 kW.

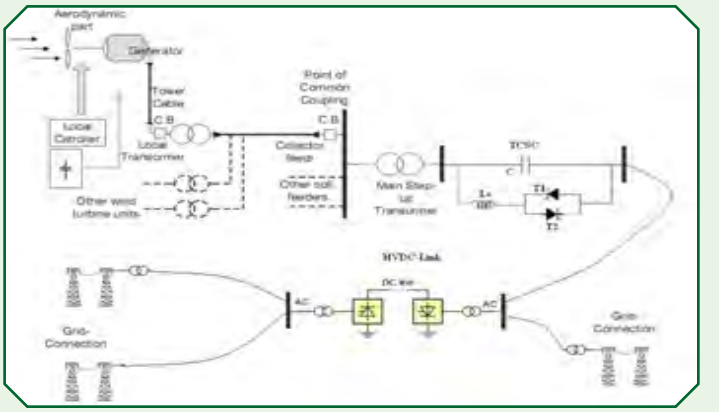
Horizontal & Vertical Axis Small Wind turbines erected for testing

Empanelment of Small Wind Turbines

The Unit had successfully pursued the models submitted for empanelment / provisional empanelment in accordance with the Modified Scheme for the Programme on "Small Wind Energy and Hybrid Systems (SWES)" of MNRE / C-WET and released the 9th List of Empanelment of Small Wind Turbine. The list has been hosted in the C-WET websites.

Power Evacuation Studies for Grid Integrated Wind Energy Conversion System

Power evacuation of grid integrated wind energy conversion system is one of the major issues faced by both the Wind turbine industry and Utility, particularly in Tirunelveli circle in Tamilnadu which has a high concentration of wind farms. A project was initiated in association with Anna University aimed at identifying the weak points in the power system to give appropriate recommendations (placement of TCSC / VSC based HVDC) to improve the power evacuation. The project has concluded with recommendations for effective utilization of installed wind power in Tirunelveli region.



Block diagram indicating placement of TCSC and USG based HUDC System

A novel hybrid energy system for supplying isolated loads with FPGA based Energy Management Scheme

The Unit has initiated a project in association with National Institute of Technology (NIT), Tiruchirappalli to design and development of a micro grid system based on hybrid renewable energy sources such as wind, solar and biomass/biogas for reliable power supply at remote locations. As part of this project, electrical generators and appropriate power electronic controllers will be designed and fabricated for this purpose. Through this, energy management using various renewable energy sources in remote locations will be demonstrated with the help of advanced digital controllers such as FPGA. The project will also involve prototype development of the complete system.

Move on in WRA UNIT

During the period of July to September 2013, 15 new wind monitoring stations have been established in 4 States (6 stations in Andhra Pradesh, 2 stations in Maharashtra, 2 stations in Tamil Nadu and 5 stations in Gujarat). Presently, 97 wind monitoring stations are operational in 15 States 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.

- Wind Resource Assessment studies for 3 sites under Extension Programme.
- Technical Evaluation for the proposed 147.50 MW wind farm project.
- Verification of procedure of wind monitoring for 37 sites.
- Repowering of existing wind farm project at Keethanur, Muppanthal and Kayather NH locations in Tamil Nadu.
- Feasibility Report onsite assessment for Lonawala in Maharashtra.

R&D Projects Progress in WRA Unit

- Installation & Commissioning of 100 m tall wind mast for offshore wind profile measurement is being carried out at Dhanushkodi, Rameshwaram.

Offshore Installation & Commissioning in progress at Dhanushkodi

- Preparation of Micro level Wind Atlas for Uttarakhand & Karnataka is under progress by using existing 5 km x 5 km mesoscale model data and the same will be submitted to National Renewable Energy Laboratory (NREL), USA for preparing 1 km x 1 km resolution data.
- To analyse and validate the flow modeling tools, 5 nos. of 50 m mast are planned to be installed in Complex sites. The sites have been selected and the concerned SNA is requested for NOCs. The execution of NOC / agreement is under progress.
- As an internal R & D project, the Unit has planned Wind Resource Assessment at 30 m in uncovered & complex terrain of Tamil Nadu. The sites have been selected and NOC obtained for 4 sites. The NOC acquisition is under progress for the remaining sites.

Estimation and Validation of Wind Power Potential at 100 m Level

Under the project Estimation & Validation of Wind Power Potential at 100 m level of 7 States in India, out of 75 stations, masts have been erected approximately in 51 stations and 31 stations have been commissioned. 3 teams have been deputed to expedite the work. Second Phase of commissioning has already successfully completed. Third Phase of commissioning is tentatively planned from 11th November 2013.

Installation & Commissioning

Special Training Course for SNAs

A Training Course on "Wind Resource Assessment & Wind Energy Technology" was successfully organized during 1st to 12th August 2013 at C-WET, Chennai specially for State Nodal Agencies (SNAs). The prime objective of this training course was to transfer knowledge and needed skills to the officials from State Nodal Agencies / Departments for effectively implementing the wind power projects and renewable energy technologies in their respective States.

The training course was attended by 37 participants from 19 States across the country (Tamil Nadu, Odisha, Andhra Pradesh, Kerala, Karnataka, Maharashtra, Assam, Arunachal Pradesh, Andaman & Nicobar, Jammu & Kashmir, Tripura, Manipur, Chhattisgarh, Gujarat, Sikkim, Rajasthan, Bihar, Ladakh and Uttarkhand) and 2 Union Territories (Goa & Pondicherry). The course was highly appreciated by the participants for its intellectual level and the way of organization. The 12 days programme included classroom lectures & factory visits and practical training sessions to provide complete knowledge transfer to the participants.

Release of course material

Factory visit to M/s. ReGen Powertech Private Limited, Tada, Andhra Pradesh and practical site visit to National Engineering College, Kovilpatti, Wind Turbine Test / Research Station at Kayathar and wind farms in and around Kanyakumari was also arranged.

Shri. A. Balraj delivering the valedictory address

Shri. A. Balraj IAS (Retd) was the Chief Guest for the Valedictory Function and distributed the certificate to all the participants.

The participants were very much satisfied by the quality of lectures and hospitality. Based on the feedback received from the participants, the range of the selected topics for the training programme was well appreciated

Stake Holders Meeting

A stake holders meeting was convened on 8th August 2013 at 12:00 noon in the Conference Hall of C-WET along with State Nodal Agencies (SNAs) and C-WET officials to create more awareness on the proposed schemes for implementation of 500 numbers of 100 m wind monitoring stations throughout the country, which is being planned to be implemented by MNRE shortly. This would facilitate to understand the actual requirements of both stake holders & SNA to complete the WRA projects on time.

Thirteen participants from wind turbine manufacturer/ developers and 33 SNA officials from 19 tates and 2 Union Territories attended the meeting. The implementation plan of the project as given below (Scheme - 1 & 2) and roles and responsibility of C-WET/SNA were briefly discussed.

Scheme – I : Under the Scheme, 40% of total project cost will be taken care through National Clean Energy Fund (NCEF), 30% shall be taken care by State Government and remaining 30% shall be borne by private Company.

Scheme – II : Under the Scheme, 40% of total project cost will be taken care through National Clean Energy Fund (NCEF) and remaining 60 % of the cost to be borne by private Company.

The mast size shall be 100m & above and measurement period shall be 2 years. The private developers have full rights to hold on the concerned site and market the data for first 3 years after completion of the measurements and after 3 years the data needs to be handed over to Government for public use and Wind Atlas preparation.

As the main objective of the proposal is to explore the wind potential of uncovered Indian States, the States namely, Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Uttar Pradesh, Bihar, Jharkhand, Madhya Pradesh, Rajasthan, Gujarat, Punjab, Chhattisgarh, Haryana, West Bengal, Odisha, NE Regions, Kerala, Tamil Nadu, Andhra Pradesh, Karnataka, UT etc. have been considered under the program.

During the meeting, private entities, stakeholders and SNA raised various quires on the proposed schemes which is being planned to implement by MNRE shortly. ED, C-WET & Unit Chief (i/c), WRA clarified all the queries.

Steps forward in TESTING UNIT

- An agreement was signed between C-WET and M/s. Jyoti Limited for Type testing of WIND JYOTI – SE 850 – 56 / 70 kW wind turbine and measurements are expected to start during the windy season of 2013.
- Instrumentation work of Xyron 1000 kW wind turbine at Richadewda Ratlam District, Madhyapradesh is under progress.
- Instrumentation work of Inox 2000 kW wind turbine with rotor diameter 100 m at Veraval (Bhadla) village (Survey No.8), Jasdan Taluk, Rajkot District, Gujarat is under progress.
- Continuous measurements for Power Curve Measurements for Garuda 700 kW WT at Melamaru thappapuram Village, (SF. N. 141/5) V. K. Pudur Taluk, Tirunelveli District is under progress.

Agreement signed between C-WET and M/s. Xyron Technologies Limited

Windy Acts at WTRS UNIT

Operation and Maintenance of 9 Nos. 200 kW MICON Wind Electric Generators are being carried out for uninterrupted operation of the machines during the windy season 2013 and power generated is being fed into the Grid.

120 m mast was successfully installed at WTRS, Kayathar.

The following visit was coordinated and showcased the Testing and R&D facilities:

- 32 participants (from State Nodal Agencies) of special training course on "Wind Resource Assessment & Wind Energy Technology" on 9th August 2013.
- 23 International participants of 11th International Training Programme on "Wind Turbine Technology and Applications" on 21st September 2013.

Marching ahead in S & C UNIT

- Agreement has been signed with M/s. RRB Energy Limited for renewal of Certificate of Pawan Shakthi 600 kW wind turbine model under Category-II as per TAPS-2000 (amended). Carried out review / verification of documentation in connection with renewal of Certificate of Pawan Shakthi 600 kW wind turbine model. Based on the review / verification, renewed Certificate has been issued to M/s. RRB Energy Limited.

Issued renewed Certificate to M/s. RRB Energy Limited

- Review / verification of documentation received from a wind turbine manufacturer for a prototype wind turbine model in connection with installation of prototype wind turbines in India as per MNRE guidelines has been completed. Organized the Committee meeting and letter has been issued by C-WET in connection with grid synchronization of the prototype wind turbine model, as decided by the Committee, to the concerned State Nodal Agency.
- Documentation / information have been obtained from various wind turbine manufacturers in connection with Revised List of Models and Manufacturers of wind turbines (RLMM) Main List. Review / verification of documentation is under progress.
- 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 another Committee meeting on prototype wind turbine models. Letters have been issued by C-WET in connection with grid synchronization of three prototype wind turbine models, as decided by the Committee, to the concerned State Nodal Agency/ State Electricity Board.
- Co-ordination works with Bureau of Indian Standards (BIS) and the members of the Working Group on Standards in connection with draft IEC Standards & draft Indian Standards are ongoing.

Highlights from ITCS UNIT

11th International Training Programme

The Unit had successfully organized the 11th International training programme on "Wind Turbine Technology and Applications" during 4th September – 2nd October 2013 at C-WET, Chennai, which was sponsored by Ministry of External Affairs (MEA), Government of India under the ITEC/SCAAP programme and supported by Ministry of New and Renewable Energy, Government of India.

The programme was attended by 23 participants from 16 countries (Costa Rica, Mali, Malaysia, Oman, Myanmar, Sudan, Ethiopia, Syria, Thailand, Libya, Armenia, Nepal, Bhutan, Ghana, Mauritius & Zambia).

The training programme was inaugurated by Shri. D. Jai Shankar, IA&AS, Protector of Emigrants, Ministry of Overseas Indian Affairs.

Shri. D. Jai Shankar lightining the kuthuvilakku

During the 29 days of the programme, 49 lectures were scheduled of which 25 lectures were taken by 18 C-WET Scientists and rest by 5 manufacturers, 6 developers, 2 consultants and 4 premier Academicians, who is having years of experience in their field.

To provide hands on experience, all the participants visited

Participants engaged in the manufacturing Small Wind Turbine workshop

M/s. MinVayu facilities at Auroville where all the participants had a chance of manufacturing Small Wind Turbine themselves after getting theoretical training of how to manufacturing the Small Wind Turbine with the local materials at low cost.

As a part of the study visit, participants were travelled to southern part of Tamil Nadu to visit Wind Turbine Test Research Station located at Kayathar and got to know about small and large wind turbine testing process and they also visited wind farms in and around Kanyakumari, where wind turbines are installed in large numbers like coconut trees.

Shri. K.C. Dhimole, FIE, Technical Advisor to Chief Minister, Government of Arunachal Pradesh was the Chief Guest for the Valedictory Function and he was kind enough to distribute the Course Certificates to all the participants.

Shri K.C. Dhimole distributing the Course Certificates to the participant

C-WET - IWTMA Knowledge Forum

C-WET & IWTMA Jointly organized one day knowledge forum on Wind Measurement, Testing & Certification by UL DEWI Knowledge Forum on 19th July 2013. Various professionals from wind industry, C-WET Scientists & Engineers attended the forum.

Visitors to the Campus

To create awareness and to motivate towards research on wind energy, achieving the indigenization and also to create awareness about the activities and services of C-WET, schools and college students are encouraged to visit the campus. During the period from July – September 2013, the following visits were coordinated by ITCS Unit with presentation on wind energy and it's status along with C-WET's activities & services during the visits and the campus renewable energy facilities were also explained / showcased in detail.

- Third year Computer Science & Engineering students of Panimalar Institute of Technology, Chennai on 3rd July 2013.
- Final year Mechanical Engineering students of Panimalar Institute of Technology, Chennai on 9th July 2013.
- 9th & 10th Standard students of RMK Residential Senior Secondary School, Chennai on 15th July 2013.
- Third year Electronics & Communication students of S.A. Engineering College, Chennai on 23rd July 2013.
- Final year Electrical & Electronics Engineering students of Prathyusha Institute of Technology and Management, Chennai on 29th July 2013.
- Third year Electrical & Electronics Engineering students of Hindustan University, Chennai on 14th August 2013.
- Third year Electrical & Electronics Engineering students of Sri Sai Ram Engineering College, Chennai on 26th August 2013.
- Third year Electrical & Electronics Engineering students of Easwari Engineering , Chennai on 23rd August 2013.
- Third year Electrical & Electronics Engineering students of VIT University, Chennai on 19th August 2013.
- Final year Electrical & Electronics Engineering students of IRT Polytechnic College on 27th August 2013.

Advances in SRRA

- The solar tower, Met mast and other related accessories for the entire 60 stations under Phase II program were delivered at C-WET during the period 12th to 27th July 2013.
- Equipments and instruments for the first 20 SRRA stations under Phase II program were delivered to C-WET, Chennai on 24th July 2013.
- Inspection of Solar Radiation Sensors and other hardware for Phase-II program was carried out by

SRRA Station at Murthal & Calibration Laboratory

Dr. R. D. Vashistha, Former DDG, IMD, Pune during the period 5th & 6th August 2013.

- Sensors / instruments / hardware were dispatched to 6 sites (Haryana-1, Punjab-2, Himachal Pradesh-2 and Chandigarh-1) on 8th August 2013 and to 8 sites (Bihar-3, Jharkhand-2, West Bengal-3) on 15th August 2013 under Phase II program.
- Dr. G. Giridhar along with GIZ official visited West Bengal for random inspection of sites selected for Phase II SRRA stations during 21st to 23rd August 2013.
- The first SRRA station under Phase-II program at Murthal, Haryana was commissioned at Deenbandhu Chhotu Ram University of Science and Technology, Sonepat University, Murthal on 29th August 2013.
- Micrositing / site selection was taken up for SRRA Phase II program in the States of Uttar Pradesh, Bihar, Odisha, West Bengal, Karnataka, Jammu & Kashmir, Maharashtra, Punjab, Haryana, Diu & Daman and Dadra & Nagar Haveli.
- The audio-video coverage of SRRA facilities at C-WET and VIT, Vellore.
- SRRA stations under Phase II program have been established in the states of Bihar, Chandigarh (1), Himachal Pradesh (2), Punjab (2), Uttar Pradesh (1), West Bengal (3) and Jharkhand (2).
- Setting up of cabin for calibration lab on the terrace of C-WET main building was completed.
- C-WET's Higher officials visited Madrid (Spain) and Amsterdam (The Netherlands) in connection with the Factory Acceptance Test and Training on the equipments for taking up the Phase II SRRA program during the period 7th to 15th August 2013.

Launch of ESD UNIT

- The Technical Specification has been finalised for purchase of New EPABX system to replace the present system.
- Proposals have been received from various suppliers for creation of a surveillance system for C-WET campus. Finalization of the plan is to be completed.
- Migration of the present mailing system to Lotus Notes mailing system is in progress to have better & faster mailing solution.
- The water pump wind mill was re-erected after maintenance & repainted work.

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

Dr. S. Gomathinayagam, Executive Director

- Keynote address on "Wind Power: the Way forward in India" in the 4th World Renewable Energy Technology Congress Conference & Exhibition & received the "Energy and Environment Foundation Global Excellence Award-2013 in Renewable Energy" at Delhi on 25th September 2013.

- Stake holder's workshop to gather views and identify issues with regard to the Renewable Energy Scenario in India organized by O/o the CAG at New Delhi on 24th September 2013.
- Round Table Discussion on "Managing Business Transformation: Reinventing Tech Models in Changing Business Environment" conducted by Bloomberg TV India in association with Airtel on 20th September 2013.
- Tamilnadu Energy Development Agency (TEDA) meet at Chennai on 17th September 2013.
- Chief Guest & Inaugurated the 2 days National Level Seminar on "Recent Trends in Renewable Energy Conversion Technology" and delivered a lecture on "Wind Energy Systems" at SA Engineering College, Chennai on 5th September 2013.
- 2nd Meeting of the Task Force constituted to prepare the comprehensive report on wind energy in India at Planning Commission, New Delhi on 3rd September 2013.
- Doctoral Committee Meeting at MIT, Chrompet, Chennai on 21st & 29th August 2013.
- Industrial Exemption Committee Meeting at Ezhilagam, Chennai on 26th August 2013.
- Stake Holders Consultation on Offshore Meeting at MNRE, New Delhi on 14th August 2013.
- 5th Executive Committee meeting of Centre for Aerospace Research at Anna University, Chennai on 6th August 2013.
- Task Force Meeting on Comprehensive Report on Wind Energy in India conducted by Indian National Academy of Engineering, New Delhi on 25th July 2013.
- Bureau of Indian Standards meeting at New Delhi on 18th July 2013.
- Solar Radiation Resource Assessment meeting at Delhi on 9th July 2013.
- Committee Meeting on Installation of Prototype Wind Turbine Models Meeting at C-WET on 4th July 2013.

K. Boopathi,

- Attended Prebid Meeting at M/s.JNPT, Mumbai for their proposed 7 MW Wind farm Project on 22nd July 2013.

S.A. Mathew

- Workshop Rapporteur on "National Consultation on Development of Offshore Wind Energy in India" held at Ministry of New and Renewable Energy on 14th August 2013.
- Invited as the Panel Member for the EEE R&D Meeting (14th Cycle) to review the Research Proposal submitted by the EEE faculty members and to give valuable suggestions to improve the ideas for their proposals at Veltech Dr. RR & Dr. SR Technical University, Chennai on 28th July 2013.

S. Paramasivan

- Attended the training programme Surface preparation of maximum loading points on wind turbine structure for strain gauge pasting ie., in mechanical load measurement of test turbine organized by IIT Madras held on 12th August, 2013.

A. Senthil Kumar

- Attended the 17th meeting of ELECTRO TECHNICAL DIVISION COUNCIL (ETDC) of BIS held at New Delhi on 18th July 2013.

P. Kanagavel

- "Wind Energy Technology" for the students of Department of Electrical & Electronics Engineering and Electronics & Communication Engineering of Chennai Institute of Technology (CIT), Chennai on 26th July 2013.
- Meeting at Ministry of External Affairs (MEA), New Delhi regarding Indian Technical & Economic Cooperation Programme (ITEC) / Special Commonwealth Assistance for Africa Programme (SCAAP) training on 6th August 2013.

Dr. G. Giridhar

- "Moving towards Green Energy in SMEs" in "Energy Conservation and Green Practices for SMEs" organized by Madras Chamber of Commerce at Chennai on 3rd July 2013.
- Technical Committee Meeting of SDAAP in SRRA project at MNRE, Delhi, under the chairmanship of Shri Tarun Kapoor, Joint Secretary, MNRE on 9th July 2013.
- Dr. Giridhar participated in the inaugural function of the first SRRA station under Phase II at Murthal, Haryana and had discussions with MNRE / SECI officials during 29th to 30th August 2013.

R. Sasikumar & Prasun Kumar Das

- Attended the Tender Committee meeting on Solar Powered Pumping System at Tamil Nadu Agriculture Engineering Department, Chennai on 2nd August 2013.

Visits Abroad

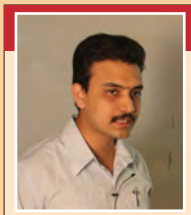
- Dr. S. Gomathinayagam, Executive Director, A. Mohammed Hussain, Unit Chief, WTRS and M.Anvar Ali, Unit Chief, ESD visited Madrid, Spain in connection with the training at Original Equipment Manufacturer (OEM) M/s. Geonica SA, Madrid, Spain during the period 9th to 14th September 2013.
- K. Boopathi, Scientist & Unit Chief (i/c), WRA delivered lecture on "Offshore wind resource assessment" in the 3rd New Energy Forum - 2013 at Xian, China organized by Euro-Asia Economic Forum (EAEF-2013) organizing Committee, China during 25th to 28th September 2013.

The following C-WET staffs delivered lecture(s) in the 11th International Training Programme on "Wind Turbine Technology & Applications" held during 4th September – 2nd October 2013 organized by Information Training and Customised Services Unit (ITCS) and in the Special training course on "Wind Resource Assessment & Wind Energy Technology" for State Nodal Agencies during 1st to 12th August 2013 organized by Wind Resource Assessment Unit (WRA).

S.No.	Topic	Speakers
1	✶ History of Wind Energy Conversion Technology and Power Generation ✶ Introduction and Status of Wind Energy Technology ✶ Wind Turbine Tower	Dr. S. Gomathinayagam Executive Director
2	✶ Role of C-WET in Indian Wind Energy Development ✶ Wind Energy Development in India ✶ Environmental Aspects of Wind Turbine Technology	P. Kanagavel Scientist & Unit Chief (i/c), ITCS
3	✶ Jawaharlal Nehru National Solar Mission and Solar Radiation Resource Assessment - an overview and Solar Radiation Resource Assessment and techniques ✶ Solar Energy and Solar Radiation Resource Assessment	Dr. G. Giridhar Scientist & Unit Chief, SRRA
4	✶ Government Policy - Wind Energy Programme ✶ Indian Government Policies, Schemes and Legal Frameworks	A. Mohammed Hussain Scientist & Unit Chief, WTRS
5	✶ Small Wind turbines and Hybrid systems ✶ Wind Turbine Foundation	Rajesh Katyal Scientist & Unit Chief, R&D
6	✶ Wind Turbine Generators	M. Anvar Ali, Scientist & Unit Chief, ESD
7	✶ Wind Turbine testing and Measurement Techniques ✶ Power Curve Measurements	S. A. Mathew Scientist & Unit Chief, WTT
8	✶ Type Certification of wind turbine and overview of Design Requirements as per IEC 61400 - 1	A. Senthilkumar Scientist & Unit Chief, S&C
9	✶ Wind Resource Assessment Techniques ✶ Wind Resource Assessment by Remote Sensing Instruments	K. Boopathi Scientist & Unit Chief (i/c), WRA
10	✶ Siting Guidelines for Wind Measurements & Instrumentation for Wind Monitoring Stations	A. Haribhaskaran Scientist, WRA
11	✶ Measurement Parameters & Data Analysis ✶ Wind Data Measurements and Analysis	G. Arivukkodi Asst Engineer, WRA
12	✶ Anatomy of Wind Turbine ✶ Overview of Wind Turbine Components ✶ Drive Train Concepts	J .C. David Solomon Scientist, R&D
13	✶ Software tools for WRA (Wind Energy Project Analysis - Windographer) ✶ Guidelines for Wind Measurements	J. Bastin Scientist, WRA
14	✶ Software tools for WRA (WAsP, Windsim, Meteodyn, Windpro) ✶ Wind Measurement and Instrumentation	B. Krishnan Junior Engineer, WRA
15	✶ Wind Turbine Gear Box	N. Raj Kumar, Scientist, S&C
16	✶ Control and Protection System in Wind Turbines	S. Arulselvan, Asst. Engineer, S&C
17	✶ Grid Integration of Wind Turbine	Deepa Kurup, Scientist, R&D
18	✶ Instrumentation for Wind Turbine Testing	M. Saravanan, Scientist, WTT
19	✶ Safety and Function Testing	Bhukya Ram Das, Scientist, WTT

Staff Transfers / Recruitment

Transfer



Mr. A.G. Rangaraj

Scientist 'B' has been transferred from S & C Unit to WRA unit with effect from 1st August 2013 onwards.

Recruitment

Mr. J. Bastin

has been appointed as Scientist 'B' in WRA Unit from 15th June 2013 onwards.

DESIGN ASPECTS OF WIND TURBINE

R. Kumaravel, BE, MBA, Ph.D
General Manager, Department of Wind Turbine Testing, ReGen Powertech Private Limited, India

ABSTRACT

As the demand for more environmentally friendly energy resources grows, energy providers have recognized the importance of wind power and have invested in the development of wind turbines. In fact, wind energy is the only renewable resource that has grown faster than predicted. Wind turbine design is the process of defining the form and specifications of a wind turbine to extract energy from the wind. This paper describes about the design aspects and the various processes involved in design of a wind turbine.

Since early recorded history, people have harnessed the energy of the wind. Wind energy propelled boats along the Nile River as early as 5000 B.C. By 200 B.C., simple windmills in China were pumping water, while vertical-axis windmills with woven reed sails were grinding grain in Persia and the Middle East.

The evolution of modern wind turbine is a story of engineering and scientific skill, coupled with a strong and entrepreneurial spirit. In the year 1896, Poul la cour, a dasnish scientist started to work on aerodynamics by theoretical and experimental aspects. After in 1920, Albert Betz derived the maximum efficiency of wind turbine, irrespective of its design.

In the last 20 years, wind turbines have increased in size by a factor of 100 (from 25 kW to 2500 kW and beyond), the cost of energy has reduced by a factor of more than five and the industry has moved from an idealistic fringe activity to an acknowledged component of the power generation industry. At the same time, the engineering base and computational tools have developed to match machine size and volume.

The engineering challenge for the wind industry is to design an efficient wind turbine to harness wind energy and turn in to electricity. This paper describes about the design aspects and the various processes involved in design of a wind turbine.

CONCEPTUAL DESIGN

The conceptual design is a preliminary drawing with an overall layout of assembling a large number of mechanical and electrical components into a machine which can convert the varying power in the wind into a useful form. This process is subject to a number of constraints, but the fundamental ones involve the potential economic viability of the design. Ideally, the wind turbine should be able to produce power at a cost lower than its competitors, which are typically petroleum derived fuels, natural gas, nuclear power or other renewables.

The conceptual design of a wind turbine consists of four main parts: tower top components, rotor, tower and foundation. The tower top components like generator is decided based on the energy generation needed and its type like synchronous, asynchronous, DFIG or permanent magnet based on the size of generator, hub is decided its function (like rigid or teetering), base frame is decided by the total mass and size of the components in the tower top. Rotor diameter is decided based on the rating of generator like 2 or 3 MW. The tower design is based primarily on wind loads, loads acting from the rotor, nacelle, blades, and additional equipment at the top of the tower in addition to wind loads acting on the tower. The foundation is designed according to the moment and axial loads resulting from the tower design and the properties of the supporting soil.

The next step to the conceptual design the design process should be a review of previous experience. This review should consider, in particular, wind turbines built for similar applications. A wide variety of wind turbines have been conceptualized. Many have been built and tested, at least to some degree. Lessons learned from those experiences should help guide the designer and narrow the options. A general lesson that has been learned from every successful project is that the turbine must be designed in such a way that operation, maintenance, and servicing can be done in a safe and straightforward way.

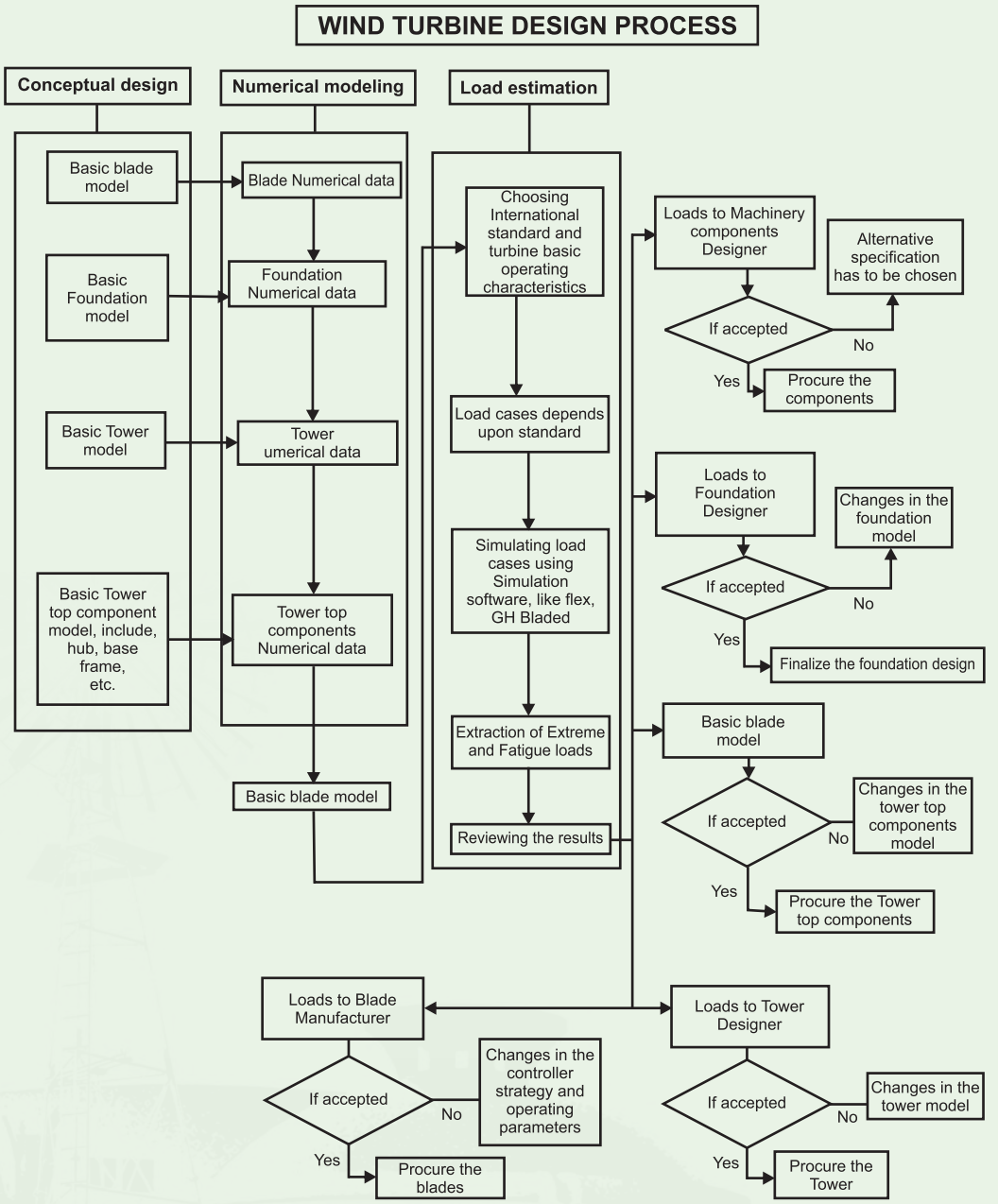
There are a wide variety of possible overall layouts for a wind turbine. The most important choices are listed below.

- Rotor axis orientation: horizontal or vertical
- Power control: stall, variable pitch, controllable aerodynamic surfaces and yaw control
- Rotor position: upwind of tower or downwind of tower
- Yaw control: driven yaw, free yaw or fixed yaw
- Rotor speed: constant or variable
- Design tip speed ratio and solidity
- Type of hub: rigid or teetering
- Number of blades

NUMERICAL MODELING AND LOAD ESTIMATION

Before the stage of numerical modeling, the designer can choose the design standard by which the design is going to followed like IEC, GL and etc. Numerical modeling is needed because practical experiments are costlier and time consuming. For numerical modeling, there are more software available like Bladed, FAST and FLEX etc.,

Early in the design process it is necessary to make a preliminary estimate of the loads that the turbine must be able to withstand. These loads will serve as inputs to the design of the individual components. Estimation of loads at this stage may involve the use of scaling of loads from



turbines of similar design. These estimates are improved throughout the design phase as the details of the design are specified. At this stage it is important to keep in mind all the loads that the final turbine will need to be able to withstand. This process can be facilitated by referring to recommended design standards.

The preliminary design must be evaluated for its ability to withstand the loading the turbine may reasonably be expected to encounter. In addition, the turbine must be able to withstand extreme loads that may only occur infrequently, fatigue induced damage. Fatigue damage arises from varying stress levels, which may occur in a stochastic manner, or as result of transient loads.

The category of loads the wind turbine must withstand includes:

- Static loads (not associated with rotation)
- Steady loads (associated with rotation, such as centrifugal force)
- Cyclic loads (due to wind shear, blade weight, yaw motion)
- Impulsive (short duration loads, such as blades passing through tower shadow)
- Stochastic loads (due to wind and its turbulence)
- Transient loads (due to starting and stopping)
- Resonance induced loads (due to excitations near the natural frequency of the structure)

After the numerical modeling and running load simulations on it, the design of components get ready.

CONTROLLER ALGORITHM & SAFETY SYSTEM DESIGN

The controller system plays a major role in the numerical modeling and load estimation aspect. The loads are mainly influenced by the controller strategies. Especially the pitching and yawing which creates more dynamics in wind turbine loads are governed by the controller. The controller has a set of algorithms which instructs each and every mechanism in the turbine what to do to maximize power and minimize mechanical loads, of course to maintain safety and protection during operation of the turbine. The controller is mostly sourced from control system designers and incorporated in to the load calculation modeling software during the stage of numerical modeling.

STRUCTURAL DESIGN AND ANALYSIS

Structural design is nothing but the designing of any structure in a three dimensional view with material properties. In this stage the structural design gets prepared by commercially available software like CATIA, PRO-E, Solid works and etc. Using the design files output from the design software, the structural analysis is executed by industrial known software like ANSYS. By this stage the stress induced and resulted from various design load simulations (from BLADED or FAST) are analyzed in ANSYS and its reliability is tested. If the strength of the designed structure is beyond or very low to the safety limit it is recommended to go back to the stage of conceptual design & Numerical modeling (preliminary design stage) and make the necessary changes and follow the same procedure in many iterative process.

DESIGN MACHINERY COMPONENTS

Machinery components are the load receptors main components of the wind turbine and so these has to be designed in such a way that to withstand for the long life of the turbine. The most important machinery components of wind turbines are:

- Pitch bearing & Pitch drives (Pitch Mechanism)
- Yaw bearing & Yaw drives (Yaw Mechanism)
- Main shaft bearing

Pitch bearing has to be designed considering the blade root loads. Yaw bearing has to be designed based on the tower top loads. The main shaft bearing has to be designed for withstanding the hub stationary and rotational loads.

DESIGN ASSESSMENT

From the stage of numerical modeling to component designing, the documents and mathematical models are provided to a third party certification body for the purpose of their assessment and evaluation. The comments from the certification body and its implementation in to the design, goes hand in hand and as an iterative process in the design. This improves and brings out a perfect design. The design assessment by the certification body is carried out based on the respective IEC or GL standard that is used for designing.

DETAILED ENGINEERING, PROTOTYPING, TESTING AND CERTIFICATION

Once the design assessment is completed, then the detailed engineering of the turbine components are made and 2D drawings for manufacturing are generated using the modeling tools like PRO-E, AutoCAD, Solid edge etc.,

The detailed engineering drawings are provided to the manufacturers and fabricators for producing the casting components, gearbox, generator, tower and other machinery components. These components are then bought out and assembled to produce the prototype turbine. The prototype turbine is then installed in the respective wind site as per the design class and type testing is carried out as per the respective IEC/GL standards. After successful completion of the type testing, the measured loads were compared with the theoretical loads that were calculated during the numerical modeling. Once the measured loads are found to be within the design loads, then a type certificate is issued to the wind turbine model. This completes the design of wind turbine.

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