
APP INITIATIVE: U.S. AND PUNJAB RENEWABLE ENERGY EXPERTS SHARE "BEST PRACTICES" IN INTEGRATING RENEWABLE ENERGY AND COGENERATION INTO THE GRID

by Tricia C. Williams, United States Energy Association



Opening Session of Workshop participants (from left to right: Tricia Williams, Senior Program Coordinator, USEA; S. Padmanaban, Senior Energy Advisor, USAID; A.S. Chhatwal, IAS Secretary, Environment & Non-Conventional Energy, Government of Punjab; T.P.S. Sidhu, Chief Executive, Punjab Energy Development Agency; and Narendra Singh, Commodore (retd), Former Advisor, MNRE, Government of India.

The **United States Energy Association (USEA)** conducted its second Workshop on Grid Connected Renewable Energy and Cogeneration/Independent Power funded by the **United States Department of State** as part of the **Asia Pacific Partnership on Clean Development and Climate (APP)** in Chandigarh, India from August 4-5, 2008. The session opened with remarks by **Secretary A.S. Chhatwal of the Government of Punjab** who stated while experts differ on how long business as usual can be sustained, there is no disagreement that everyone must begin to think of innovative routes beyond conventional energy sources and must pay close attention that they are a win-win solution that is economically viable and environmentally friendly. **Chief Executive T.P.S. Sidhu of the Punjab Energy Development Agency (PEDA)** highlighted the many initiatives the Punjab Energy Development Agency is taking in the next few years including 350 MW of biomass projects allotted and their intent to generation 600-700 MW of renewable energy by the end of 2010. He also emphasized the need for more interaction through workshops and task force activities to build on the momentum.

BACKGROUND

The objective of the workshop was to promote policy and regulatory initiatives and encourage incentives to accelerate the development and interconnection of renewable energy and distributed generation projects into the Indian power system.

Panel discussions centered on:

- Successful technologies and projects in wind, biomass, cogeneration, and solar energy,
- Interconnecting to the power grid while maintaining grid reliability and stability, and
- Successful policies, regulation and incentives for renewable/cogeneration development.

FUTURE ACTION ITEMS FOR APP

- Further discussion on interconnecting renewable energy and cogeneration facilities at the 11 kv level, rather than the 66 kv level.

- Discussion with regulatory commission on creating policies that mandate wind technology with reactive power capabilities.
- Discussion on ways to “firm up” power or other alternatives to address intermittency issues.
- Information exchange on hybrid systems such as wind/solar.
- Information exchange on Renewable Energy Credits.
- Information on benefits, technical specifications, and costs of net metering.

WIND ENERGY

Mr. Dillip Guru of GE Energy discussed the technology available that helps mitigate interconnection and intermittency concerns. Mr. Guru highlighted problems occurring in Europe with high wind penetration and stated India can avoid large voltage variations and uncontrollable power from wind turbines by installing turbines with grid friendly performance features that regulate voltage, ride-through faults, and control power output. Voltage control will regulate the grid voltage at the point of interconnection, regulate total wind plant reactive power through the control of individual turbines, and



Mr. Jaspal Deol of SMUD speaks on the panel with Mr. M.P. Singh and Mr. Balour Singh of PEDDA.

On the operational side, **Mr. Jaspal Deol of the Sacramento Municipal Utility District (SMUD)** stated his utility had successfully integrated its 100 MW’s wind farm into the grid and SMUD is in the process of expanding its wind farm by adding another 128 MW’s of wind generation. Many of the participants questioned whether wind could be used as part of a hybrid system with solar for example to offset intermittency problems. Mr. Deol said SMUD is analyzing pump storage to firm up wind energy when it is in excess and mentioned this may be a possibility for India as well.

Suzlon and GE Energy mentioned that one of the main issues is the difficulty in getting the equipment into the remote hilly areas where wind is best as the roads either do not exist or are not large enough.

Speakers and participants agreed that regulation was the key to increasing the development of wind energy and all felt the new incentives from the Ministry of New and Renewable Energy and state tariffs were favorable towards its development.

BIOMASS

Several types of biomass generation were discussed by Mr. M.P. Singh of PEDDA and Mr. Deol of SMUD. **Mr. Deol of SMUD** gave an overview of the Kiefer Landfill gas

and minimize grid voltage fluctuations even under varying wind conditions. Voltage regulation is very important as the wind generator cannot be in constant power factor mode. Mr. Guru also focused on ride-thru capability which allows the generator to stay online and feed reactive power into the grid through system disturbances while meeting transmission reliability standards similar to those of thermal generators. New technology can support reactive power even when there is no wind but regulators will need to insist on the use of the technology in order for everyone to begin using it. Mr. Guru concluded by stating reactive power drawal should be incentivized or disincentivized based on local voltages, generators should be able to ride through transient faults, and active power control that limits the rate of change in power under varying wind conditions should be utilized based on system frequency.

Results:

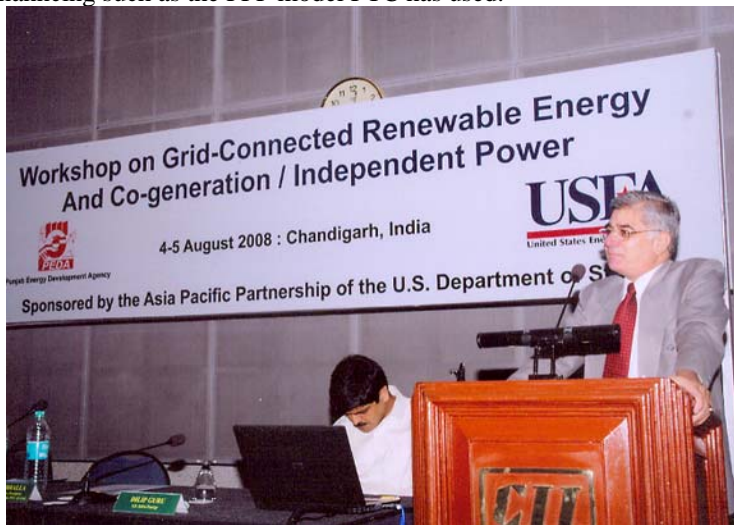
- The Punjab State Electricity Board requested the Punjab Energy Development Agency speak to the Punjab government to encourage the sale of power from IPPs ;
- The Punjab Energy Development Agency requested the Punjab State Electricity Board and the Punjab State Electricity Regulatory Commission streamline their procedures to make it easier for renewable energy and cogeneration to connect to the grid, especially small generators;
- The Punjab Energy Development Agency will propose a state policy to provide Renewable Energy Credits (REC);
- The Punjab Energy Development Agency will work with the state government on ways to improve access to biomass fuels and will suggest new policies urging farmers not burn paddy straw prior to collection by biomass generators;
- The Punjab Energy Development Agency requested Orb Energy – an Indian solar project developer – to expand its portfolio by developing solar projects in Punjab; and
- The Punjab Energy Development Agency requested additional information from Turbomach India – a project developer and manufacturer of medium size gas turbines - on their equipment and its potential applications in Punjab.

project that uses three Caterpillar 3616 engine generator sets of 3MVA for 9 MW with a plan to expand to 12 MW total. The facility was a non-engineered landfill that uses unseparated solid waste that is dumped, topped with layers of soil and then topped with clay or sheeting. He emphasized that large units are not needed for waste to energy facilities. He also discussed the Cal-Denier digester gas project at a local dairy farm. This project is an anaerobic digester that uses 3x 85 kw three phase generators that produces 3.35 Gw hours per year. The digester waste is then used as manure.

Mr. M.P. Singh of PEDDA stated that they are placing a big emphasis on biomass as they have about 342 MW potential. However, there are several barriers that are currently being reviewed under a UNDP program with the Government of India. One barrier in particular several participants mentioned was the scarcity of biomass fuel. Farmers are all harvesting at specific times per the state government and then burn the paddy straw immediately so they can turn over the land quickly for the next crop. Mr. Singh replied that no biomass facility should rely solely on one fuel; they should have multi-fuel options. However, after much discussion it was agreed that this should be brought up to the state government to enact new policies to make collection easier and to possibly create a storage facility for biomass fuel.

COGENERATION

Mr. Arun Bhalla of PTC India Ltd insisted India must capture distributed generation and industry captive power. Mr. Bhalla stated that distributed generation technology is the most viable solution for meeting power demand using innovative financing such as the PPP model PTC has used.



Mr. Arun Bhalla of PTC India Ltd speaks with Mr. Dillip Guru of GE Energy.

Mr. Pradeep Yadav of Turbomach India

explained his company's turbine products and the various applications, such as shopping malls and information technology buildings. Turbomach turbines have 75-90% thermal efficiency and can use any liquid or gas in the combustor, including good quality biogas. He stated these turbines save up to 30% of the fuel burned with cogeneration and are dual fuel combustors. Workshop participants had many questions about the ability to use biomass in this system and sizing of turbines to be cost effective. Mr. Yadav recommended units of 3.5 MW and greater for optimal cost effectiveness. Mr. Deol of SMUD, however, cautioned the participants on relying too heavily on biomass as the supply will run out.

SOLAR ENERGY

Mr. Ramesh KN of Orb Energy and Mr. Deol of SMUD led a discussion on current solar photovoltaic technology and operational efficiency. Mr. Ramesh stated Orb Energy is beginning to put solar in wind farms for hybrid units but is not finding an attractive investment environment for solar in general as investors are still skeptical. He suggested a power purchase agreement of at least 20 years and low interest finance similar to Sri Lanka's policy to increase investment and the market share of solar in India. Participant Narendra Singh stated another problem is that the Ministry of New and Renewable Energy (MNRE) assumed 4% for financing, an incorrect assumption that is also affecting financing of solar projects in India. **Mr. Deol of SMUD** highlighted the incentive programs in California for solar PV including the carbon credit given to SMUD and federal and state tax incentives.

Mr. Ramesh then highlighted technology including a newer type of panel called thin film which has 10-20% better performance and is flexible enough to be installed on rounded rooftops. Solar panels in general degrade about 1% a year. Participants had many questions about tracking technology which Mr. Ramesh said costs 20% more but produces 20% more and is good in big installations. However, Mr. Deol of SMUD stated that in his utility the capital costs of tracking were not worth the increased cost and that simply getting the angle right with non-tracking technology was a more economical and efficient choice.

One of the main discussion items in this panel revolved around cost. Orb Energy cited the investment for 10 MW in India is 25 crores per MW (approximately \$6.25 million U.S.), 18 crores per MW for the panels and 7 crores per MW for evacuation equipment. Rooftop systems with a battery would cost 400,000 Rs (\$10,000 US) as currently there is no policy for grid connection of rooftop solar panels in India. Rooftop PV solar that could connect to the grid would cost 250,000 Rs (\$6,250 US). Mr. Deol of SMUD cited the cost of a 1 MW solar farm at \$6.5 million installed and a 2 kw solar rooftop PV system for homes at \$20,000 installed.

Participants were also very keen to learn more about solar thermal technology and existing plants in the US. Mr. Deol of SMUD stated no new facilities have been built in California since the 1980s but that many U.S. utilities are analyzing the costs and new technologies to determine if solar thermal could be a way to meet their renewable portfolio standards.

INTERCONNECTING TO THE POWER GRID WHILE MAINTAINING GRID RELIABILITY AND STABILITY

Mr. Prem Sagar of the Punjab State Electricity Board (PSEB) stated requirements for interconnecting to the grid. PSEB is concerned about constraints on system reliability especially when they are unsure if the power is firm or not. The Punjab state grid code states all facilities are connected at the 66 kv level, a point that raised many questions among workshop participants and **Mr. Deol of SMUD** who saw this as a potential barrier that leads to increased cost and system losses. Mr. Deol shared his experience with distributed generation being successfully integrated into the distribution system at the current levels. Higher penetration (33% RPS) of distributed generation will need additional technical analysis and solutions such as Smart Grid. PSEB stated they need to see the impact on the substation and can have major problems with day ahead scheduling if power is not firm.

Regarding equipment needed to interconnect, the equipment must remove the fault at the generator end at the first instance so it does not go to the PSEB grid. Equipment must also be installed for future expansion and this should be taken into consideration when submitting plans to PSEB for interconnection.

Substation equipment must be approved and the developer must coordinate the setting of relays with PSEB. This approval process goes through the substation as well, which many in the audience perceived as extending the amount of time to get approval. Further, they have to match load, meaning if the developer's generation is not needed, it does not run.

Mr. Deol of SMUD reviewed their generator interconnection process and requirements, basic protection functions required at different kW and kV levels, operational requirements, and voltage performance parameters. He stated that the standardization of equipment and processes has greatly accelerated the integration of renewable energy and cogeneration into the California grid and reiterated that grid stability has not been an issue in California.



From left to right: T.P.S. Sidhu, PEDA; Secretary Chhatwal, Government of Punjab; Jaspal Deol, SMUD; and Narendra Singh.

SUCCESSFUL POLICIES, REGULATIONS, AND INCENTIVES

Mr. Deol of SMUD discussed California Rule 21 which greatly simplified interconnection procedures in California and created a consistent set of processes and application of rules. In particular, Rule 21 created net metering legislation, allowed for easy installations based on the use of certified inverters, created one flowchart for all interconnection reviews by utilities, and created a certification process for equipment. Rule 21 also included some technical aspects as well such as setting the under/over voltage to 88% to 110% of nominal and the under/over frequency to 59.3 Hz to 60.5 Hz (assuming 60 Hz nominal).

PUNJAB PARTNERS AND WORKSHOP PARTICIPANTS

Several Indian and U.S. organizations partnered with USEA for this workshop including Punjab Energy Development Agency, Ministry of New and Renewable Energy, PTC India Limited, Punjab State Electricity Regulatory Commission, Punjab State Electricity Board, GE Energy, U.S. Agency for International Development, and the government of Punjab. Expert speakers included Jaspal Deol of the Sacramento Municipal Utility District, Dillip Guru of GE Energy, Rakesh R.N. of Orb Energy, and Pradeep Yadav of Turbomach India.

The following companies and agencies participated in the two day workshop: Punjab Energy Development Agency, Ministry of New and Renewable Energy, Punjab State Electricity Board, Punjab Electricity Regulatory Commission, Sacramento Municipal Utility District, PTC India Ltd, Turbomach India, GE Wind, USAID, Orb Energy, Thermax Limited, Suzlon Gujarat Wind Park Ltd., Agni Partners, AzurePower, Inc., blueTrii, Bureau of Energy Efficiency of the Government of India, Chandigarh Distillers & Bottlers Limited, Cheema Spintex Limited, Foods Fats & Fertilisers Ltd., Future Enviro Energy and Computing Solutions, Green Planet Energy, Greenfield Energen Ltd., Hindustan Infrastructure Inc., Indian Renewable Energy Development Agency Limited, Insolar, JCT Limited, Malwa Power Limited, Morinda Co-op Sugar Mills, Moser Baer Photo Voltaic Ltd., Nawanshahr Co-op Sugar Mills Ltd., P&R Infraprojects Limited, Punjab

State Council for Science & Technology, Punjab State Federation of Cooperative Sugar Mills Limited, Polyplex Corporation Ltd., Ravi Energie, Reliance Industries Limited, Shreyans Industries Limited, Synergy Telecommunications, Univeral Bio-Mass Energy Pvt. Ltd., Velankani Information Systems Pvt. Ltd., and Winsome Yarns Limited.



For more information, contact Tricia Williams at twilliams@usea.org.