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Wind Integration -- By All Means Available

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Abstract:

There is an increasing interest in renewable energy production both from economic security and environmental perspectives. The State of California has set a target of 30 % penetration from all renewable sources by 2020. Wind energy will play a key role in realizing such aggressive targets. At today's modest (? 1%) penetration levels, wind energy is integrated into the grid by legislative fiat. At deep penetration levels called for, integration of utility-scale wind production into the electricity grid poses serious engineering and market challenges. These are due to the variability, intermittency, and uncontrollability of wind power.

In this talk we investigate ways to use a portfolio of available means to achieve deep penetration of wind generation in the current grid. This portfolio includes co-located storage, fast-acting local production, optimized contracts, and novel market instruments.

We introduce a linear programming formulation that enables us to study sensitivities and conduct parametric studies. We argue that co-located storage has a marginal economic utility of ? 17 MW-hours-per-day for each MW-hour of storage. Our studies suggest that it will become necessary to waste some produced wind energy (when production is lower than ? 30% of nameplate capacity) to permit reliable servicing of electricity contracts. This is due to the difficulty associated with forecasting produced power at low wind levels. Finally, we suggest the use of risk-limiting contracts to achieve firming of wind-power. In these auditable contracts, the producer receives a short reprieve which enables them to offer power predictably by avoiding ramp times. We conclude by discussing how variability risk should be shared among participants in an electricity network while respecting security constraints.

Short Bios:

Prof. **Kameshwar Poolla** received the Bachelor of Technology degree from the Indian Institute of Technology, Bombay in 1980, and the Ph.D. degree from the University of Florida, Gainesville in 1984. He has served on the faculty of the Department of Electrical and Computer Engineering at the University of Illinois, Urbana from 1984 to 1991. Since then, he has been with the University of California, Berkeley where he is a Professor of Mechanical Engineering and Electrical Engineering & Computer Sciences. He currently serves as the Director of the IMPACT center for Integrated Circuit manufacturing at the University of California.

Dr. Poolla has also held visiting appointments at Honeywell, McGill University, M.I.T., Michigan, and Columbia. In 1999, he co-founded OnWafer Technologies which offers metrology based yield enhancement solutions for the semiconductor industry. OnWafer was acquired by KLA-Tencor in 2007. He has also serves as a technology and mergers/acquisitions consultant for Cadence Design Systems.

Dr. Poolla has been awarded a 1988 NSF Presidential Young Investigator Award, the 1993 Hugo Schuck Best Paper Prize, the 1994 Donald P. Eckman Award, the 1998 Distinguished Teaching Award of the University of California, the 2005 and 2007 IEEE Transactions on Semiconductor Manufacturing Best Paper Prize. Professor Poolla's research interests include Renewable Energy Systems, Modeling and System Identification, Semiconductor Manufacturing, and Sensor Networks.