Integration of Renewable Energy into the Smart Grid

ABSTRACT

Motivated by deepening concerns over climate change, there is great interest in the use of renewable sources of energy such as wind and solar for meeting our electric energy needs. There are aggressive goals throughout the world for large increases in the fraction of the total electric energy consumption from such renewable sources. For example, California has set a target of 33% penetration from all renewable sources by 2020. Wind and solar energy will play a key role in realizing such aggressive targets.

At these deep penetration levels, integration of wind and solar power production into the electric grid poses serious engineering and market challenges. These are due to the inherent uncertainty, variability, and uncontrollability of wind and solar power.

Today, wind and solar energy is assimilated into the grid by legislative mandates and subsidies. The variability in production is absorbed by scheduling additional operating reserves. This extra-market approach works at today’s modest penetration levels, but will become untenable as wind penetration increases – for both economic and environmental reasons.

How will we deal with this uncertain and variable renewable energy tomorrow? In this talk, we investigate a portfolio of means needed to achieve deep penetration of wind power generation. These include optimized bidding strategies, improved statistical modeling and forecasting, co-located energy storage, fast-acting local generation, and novel market instruments. In this talk, we will describe some recent results in these directions. We will present some initial analytical results as well as numerical results on real data from wind energy production. The talk will conclude with a discussion of future research issues.

BIO

Pramod P. Khargonekar received his B. Tech. Degree in electrical engineering from the Indian Institute of Technology, Bombay, India in 1977, and M.S. degree in mathematics and Ph.D. degree in electrical engineering from the University of Florida in 1980 and 1981, respectively. After holding faculty positions in Electrical Engineering at the University of Florida and University of Minnesota, he joined The University of Michigan in 1989 as Professor of Electrical Engineering and Computer Science. He became Chairman of the Department of Electrical Engineering and Computer Science in 1997 and also held the position of Claude E. Shannon Professor of Engineering Science. In July 2001, he rejoined the University of Florida and served as Dean of the College of Engineering from till July 2009. He is currently Eckis Professor Electrical and Computer Engineering at the University of Florida.