

# Wind Power Interconnection

## Standards for Wind under and over 20 MW

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NRECA Webcast

December 8, 2005

Image courtesy of NEG Micon



# Wind Community Need to Communicate

- Growing worldwide recognition of economics of wind energy and need to design for “high penetration.”
- \$6 Gas → 60,000 MW cost-effective wind in US in under 20 MW installations
- History of poor communication among wind developers, turbine manufacturers, grid operators, and “engineering community.”



# Addressing Wind Power Grid Reliability

Northeast Blackout of August 2003 turns attention to need for better planning and clearer rules for wind sooner rather than later.



# Addressing Wind Power Grid Reliability

## AWEA “Grid Code” Development Process

- Assemble critical mass of “wind industry” (turbine manufacturers, component suppliers, developers/operators, engineering consultants) in the UTILITY-SCALE market
- Examine other “Grid Code” efforts worldwide (e.g., Germany, Spain, UK, Greece, Australia, ERCOT, WECC, NYISO)

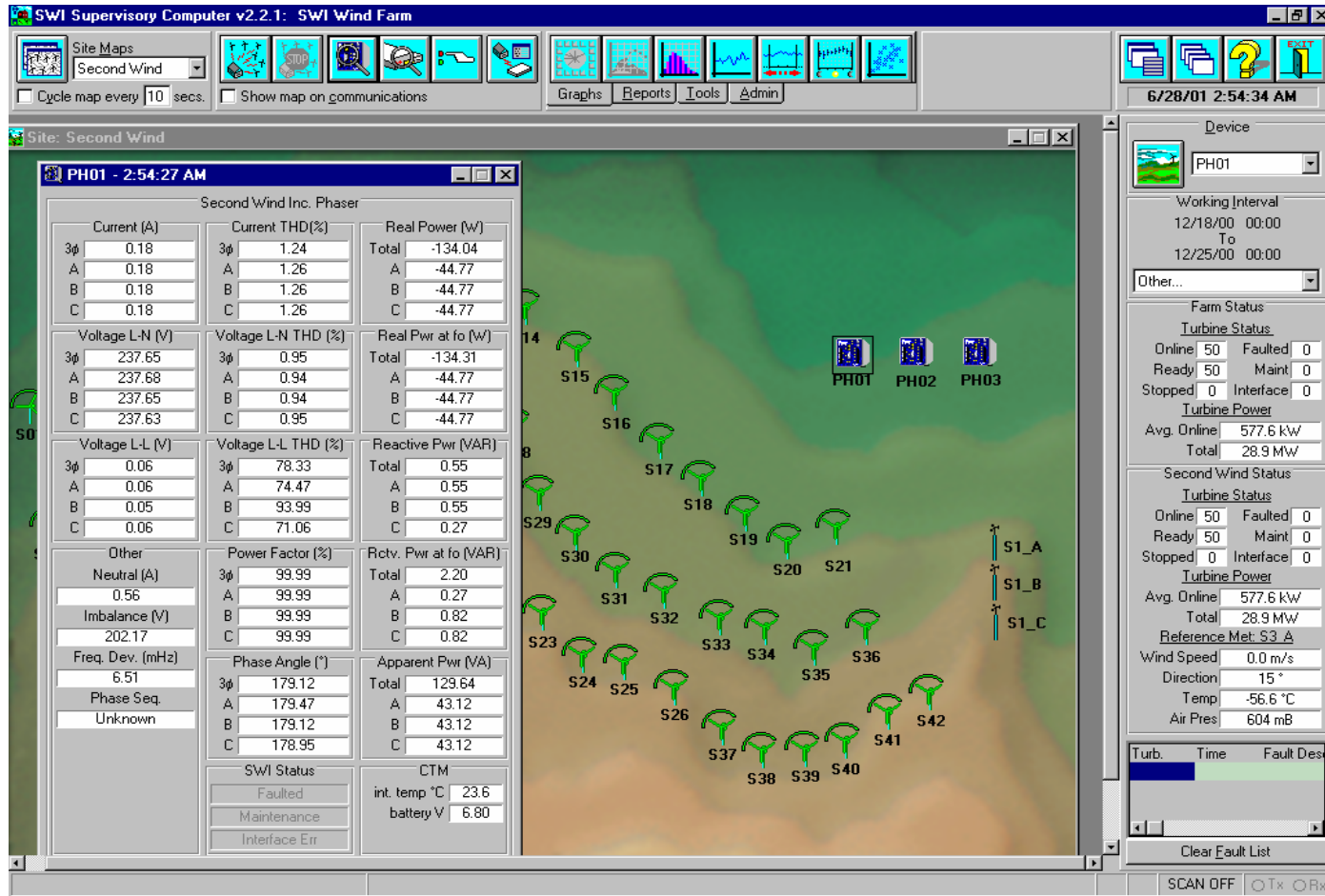


# Addressing Wind Power Grid Reliability

- Assess near term product development plans that could result in “grid friendly” wind turbines/wind farms.
- Include balance of system engineering, and add-on technology choices in 20+ MW installations



# Addressing Wind Power Grid Reliability- Supervisory Data



# Progress on 20+ MW

- AWEA prepared FERC filing early 2004
- FERC Order 661, June 2005
- AWEA settlement filing with NERC, September 19, 2005
- Compliance filings due Dec 30, 2005



# Interconnection for Wind Power

- What it IS - standards for electrical quality
  - Low Voltage Ride Through
  - Reactive Power
- What it is NOT- Policy on services, costs, capacity contribution
- What else is in it?
  - SCADA capability for windfarms to allow 2-way communication



# Interconnection for Wind Power

- What it IS - Low Voltage Ride Through
- Why is LVRT important?
  - Typical wind turbine design responds to a drop in voltage by disconnecting generator from the grid
  - When wind was a minor player, grid operators did not worry about this loss of supply. Simpler to ignore in an emergency.



# Why Low Voltage Ride Through Is Important

## What does LVRT provide?

- Redesign of wind turbine components to survive a drop in voltage to avoid disconnecting generator from the grid
- When wind is a major player, grid operators need this supply. Loss of supplies in an emergency increases the problem, lowering voltage even further.



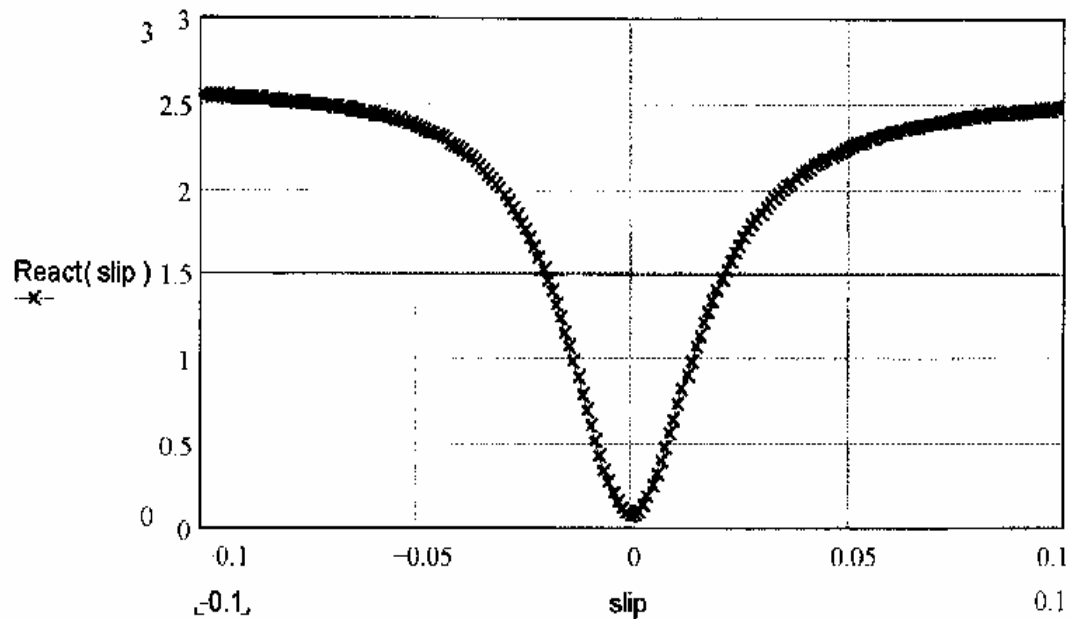
# Reactive Power Standard

What does a Reactive Power standard mean to wind technology?

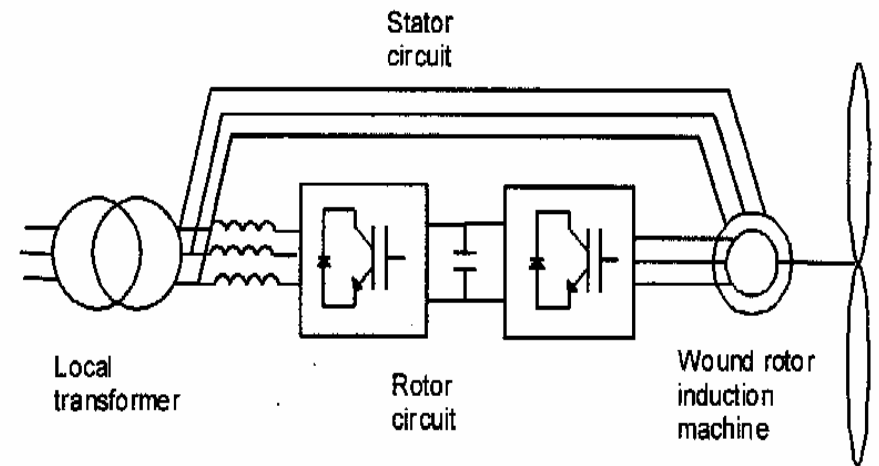
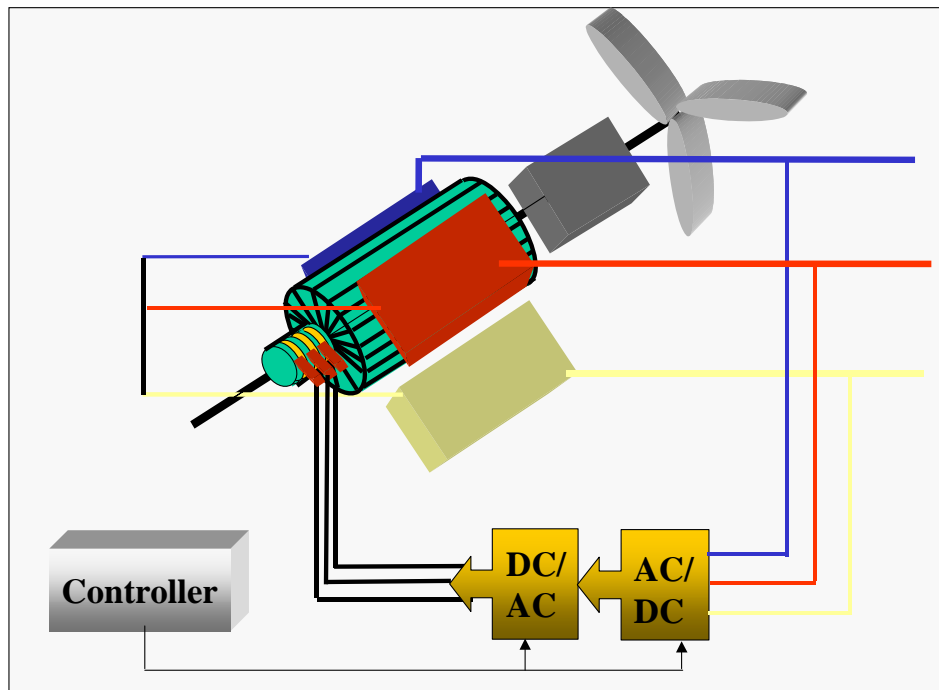
- Typically, wind turbines use induction motors, and require an electric field provided by the grid – that consumes reactive power
- Various and several turbine designs have improved on this, but the lowest common denominator has been that wind consumes VARs, and does not provide reactive power



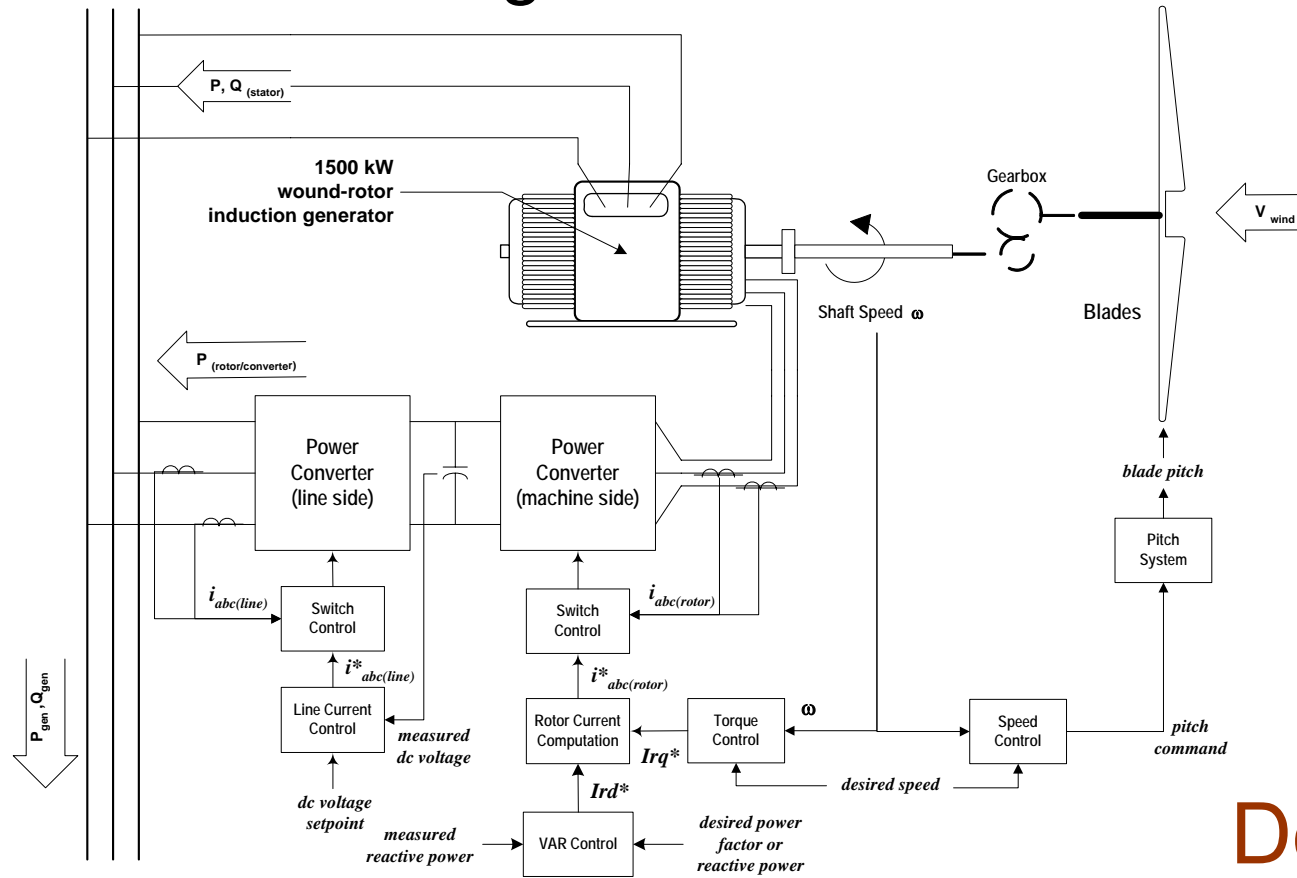
# Traditional induction-style reactive demand



# 1990's Designs to reduce VAR requirements



# 2000's Designs to meet VAR standards



Doubly-Fed



# Differing Standards

	IEEE	WECC	FERC
PF Under 10 MW	Yes- neutral	No	No
LVRT under 10 MW	No	No	No
PF 10-20 MW	No document	No	No
LVRT 10-20 MW	No document	Yes	No
PF over 20 MW	No document	Yes	+/- .95
LVRT over 20 MW	No document	Yes	Yes



# Progress Under 20 MW

- AWEA participated in settlement talks NRECA and others, Fall of 2004
- FERC Order 2006, May 2005
- AWEA filing with FERC suggested Reactive Power, October 25, 2005
- FERC Order 2006-A, November 22, 2005



# AWEA suggestion

- To fill gap in rules between 10 and 20 MW, unity power factor should be minimum requirement.
- Where system study shows need, wind should provide +/- .95 capability.



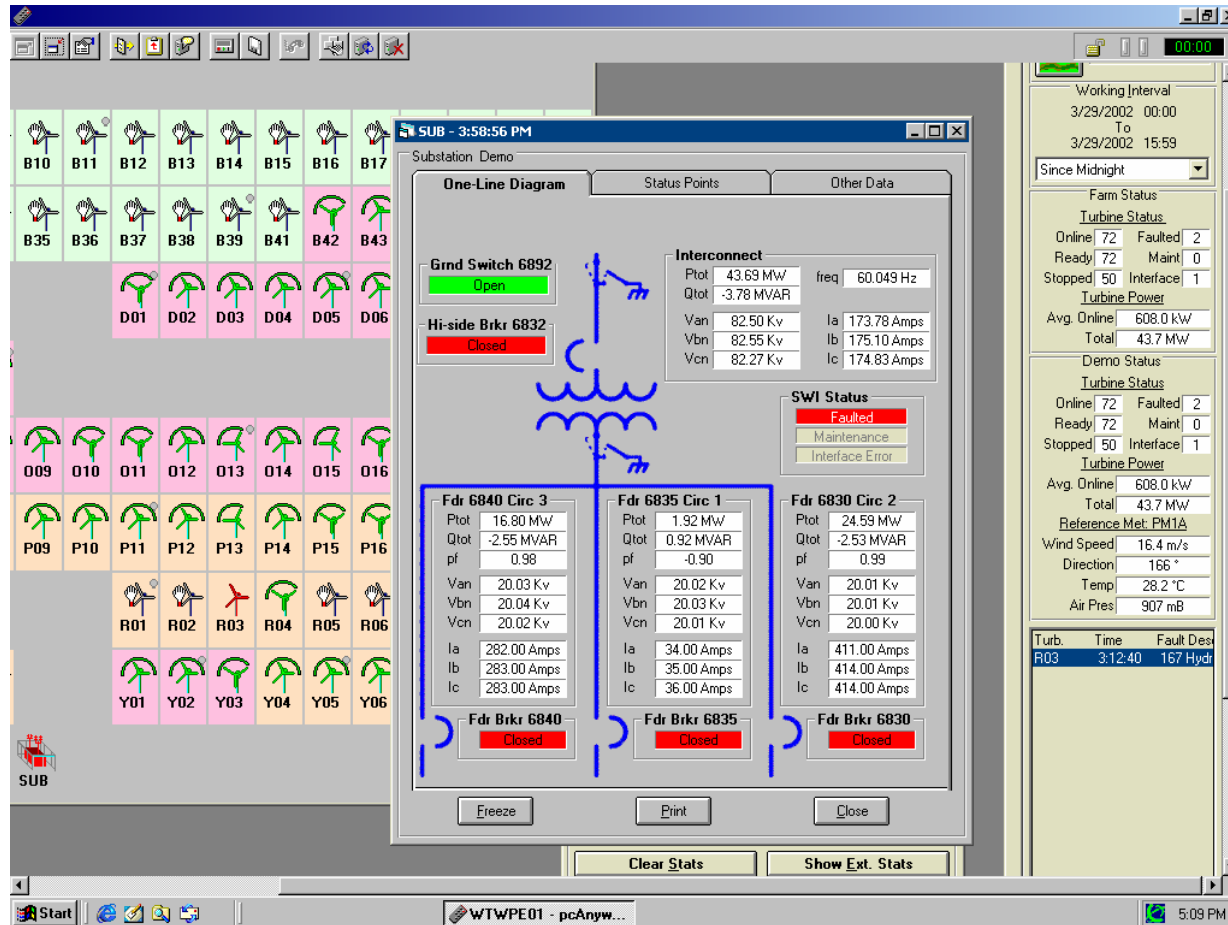
# Supervisory Control and Data Acquisition (SCADA)

## Why is SCADA important?

- Generation communications with the grid operators on output, near-term changes, settings and readiness all aid the grid operations
- To allow future wind functions in coordination with grid operators that may be described in contracts or operating protocols.



# Why SCADA is important



# Questions?

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