

Illinois Institute of Technology

# Wind Consortium

September 2010



# A World-class University-Industry Consortium for Wind Energy Research, Education, and Workforce Development

Lead Organization: Illinois Institute of Technology

Principal Investigator: Mohammad Shahidehpour

## Members of the World-Class Wind Energy Consortium

<b>University Members</b>	<b>Point of Contact</b>
Illinois Institute of Technology (Lead)	Mohammad Shahidehpour, Professor
University of Chicago	John Birge, Professor
Southern Illinois University	Morteza Daneshdoost, Professor
University of Castilla - La Mancha (Spain)	Antonio Conejo, Professor
University of São Paulo (Brazil)	Newton Bretas, Professor
Aristotle University of Thessaloniki (Greece)	Anastasios Bakirtzis, Professor
Polytechnic University of Bucharest (Romania)	Mircea Eremia, Professor
<b>National Labs Members</b>	<b>Point of Contact</b>
Argonne National Laboratory	Jianhui Wang, Technical Staff, EEESA Center
National Renewable Energy Laboratory	Fort Felker, Director of the National Wind Technology Center
Sandia National Laboratory	Matthew Barone, Senior Staff Member, Wind Energy Technology
<b>Industry Members</b>	<b>Point of Contact</b>
<b><i>Wind Turbine Companies</i></b>	
GE Energy	Steve Moffitt, Account Executive
Viryd Technologies, Inc.	Matt Arnold, Manager
Acciona Wind Energy USA	Frank Bristol, Director of Transmission
<b><i>Wind Energy Developers</i></b>	
Invenergy, LLC	Michael Polsky, President and CEO
Pampa Energia Eolica (Brazil)	Edgar Pereira, Director
PS Wind Management (Romania)	Radu Popoiu, Managing Director
<b><i>Power Transmission System Operators</i></b>	
ComEd/Exelon	Terence Donnelly, Senior Vice President
ISO New England	Eugene Litvinov, Director of Business Architecture and Technology
British Columbia Hydro, Canada	Ebrahim Vaahedi, CTO
<b><i>Wind Energy Control Devices and Software Companies</i></b>	
Honeywell	Tariq Samad, Corporate Fellow
Dakota Power	Richard Gowen, President
EnerNex Corporation	Erich Gunther, Chairman and CTO
SmartSignal Corporation	James Gagnard, President and CEO
Innovation Technology Applications Company	Alan Cain, President
<b><i>Energy System Consultants</i></b>	
Keyworks	Kurt Yeager, President and CEO
Electric Power Research Institute	Daniel Brooks, Manager, System Studies
AREVA T&D	Jay Giri, Director of Power System Technology & Strategic Initiatives
Intelligent Power Solutions	John Kelly, President
McCoy Energy	Paul McCoy, President
Wiedman Power System Consulting	Thomas Wiedman, President

# Project Objectives

The consortium's research and development objectives will be focused on addressing several challenges identified in the "20% Wind Energy by 2030" report:

- 1) Wind Technology.** The consortium members will develop control algorithms for enhancing the reliability of wind turbine components.
- 2) Grid System Integration.** The consortium members will develop advanced operation and planning tools for accommodating the high penetration of intermittent wind energy in electric power utility systems.
- 3) Research & Development.** The consortium members will educate the stakeholders on critical issues related to the wind energy research and development.
- 4) Workforce Development.** The world-class wind energy education and research programs developed by the consortium will outlast the proposed two-year period of the project.

# Project Phases

**Phase I** – Partnership for Wind Unit Installation

**Phase II** – Wind Turbine Reliability Research

**Phase III** – Wind Energy Research and Development

**Phase IV** – Workforce Development for Sustaining the Wind Energy Research and Development in US

**Phase V** – Final Reporting

# Phase I – Partnership for Wind Unit Integration

## **Task 1.0 – Procure a 1.5MW GE Test Wind Turbine**

IIT has procured an existing turbine from Invenergy, located in Grand Ridge, Illinois.

## **Task 2.0 – Install an 8KW Viryd Test Wind Turbine**

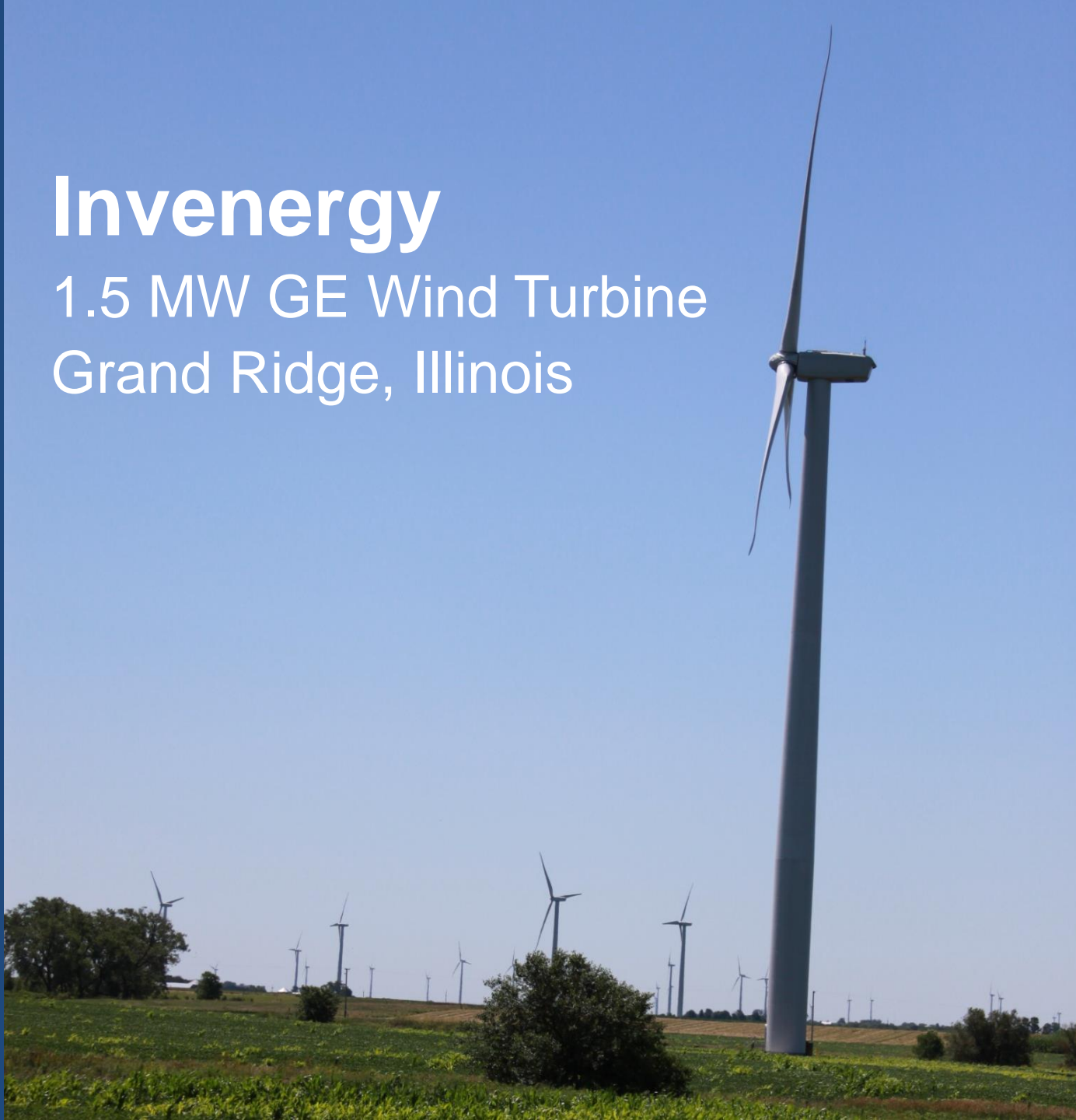
Viryd has installed an 8KW lab unit in one of Siegel Hall's Electrical and Computer Engineering Laboratories.

## **Task 3.0 – Install a Small Wind Turbine for Public Awareness**

IIT is procuring an additional 8 KW field unit to be deployed on IIT's main campus Stuart Field. Projected completion: Q1 FY2011

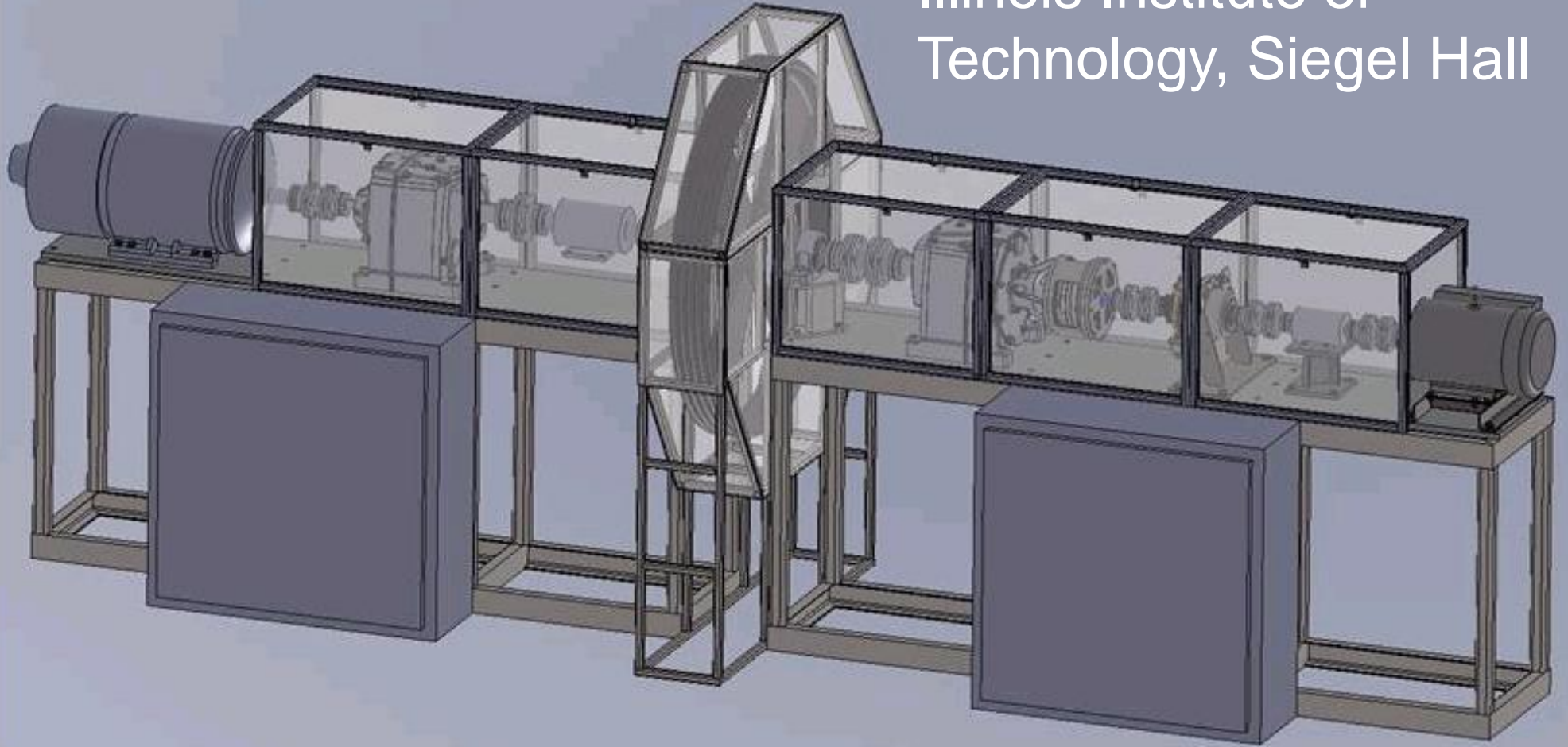
# Invenergy

1.5 MW GE Wind Turbine  
Grand Ridge, Illinois



# 8 kW Viryd Turbine

Illinois Institute of  
Technology, Siegel Hall





# Stuart Field Looking West



**8 kW Viryd Turbine**  
Illinois Institute of  
Technology, Stuart Field

# Phase II – Wind Turbine Reliability Research

## **Task 4.0 GE Wind Turbine Reliability Study**

Consortium members will participate in the development of advanced rotor control and drive train control concepts, robust sensors for blades, improved aero-elastic models, and new controls beyond proportional integral derivatives.

## **Task 5.0 Viryd Wind Turbine Reliability Study**

With a wind unit available in the lab setting, stress test will be done to evaluate turbine reliability under extreme conditions

## **Task 6.0 Noise Reduction in Wind Turbine Design through Fluid Dynamics and Acoustics**

Wind turbine designs will be evaluated using Large Eddy Simulation (LES) of the acoustics and unsteady flow around a wind turbine for the purpose of assessing wind turbine noise and unsteady loading.

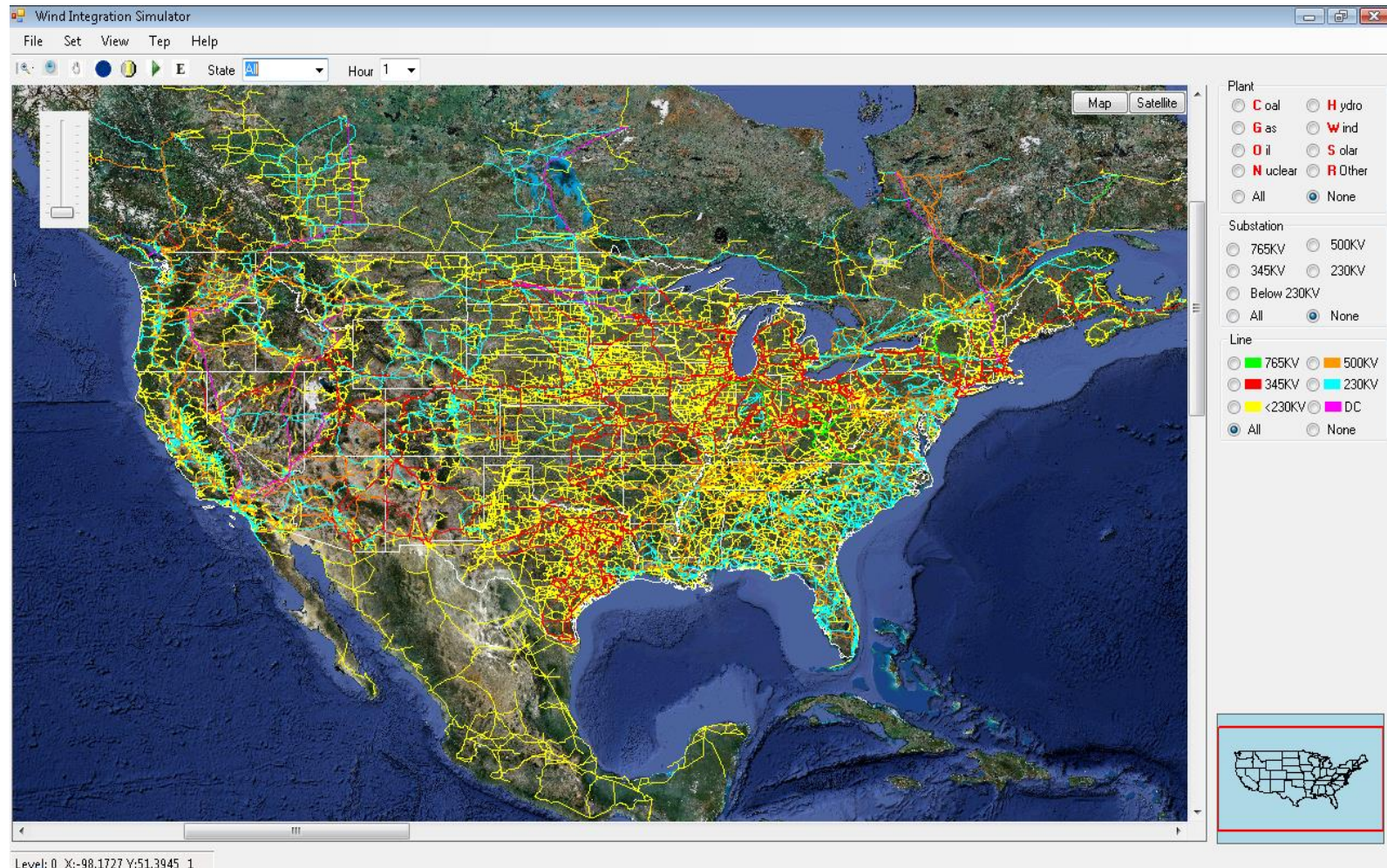
# Phase III – Wind Energy Research & Development

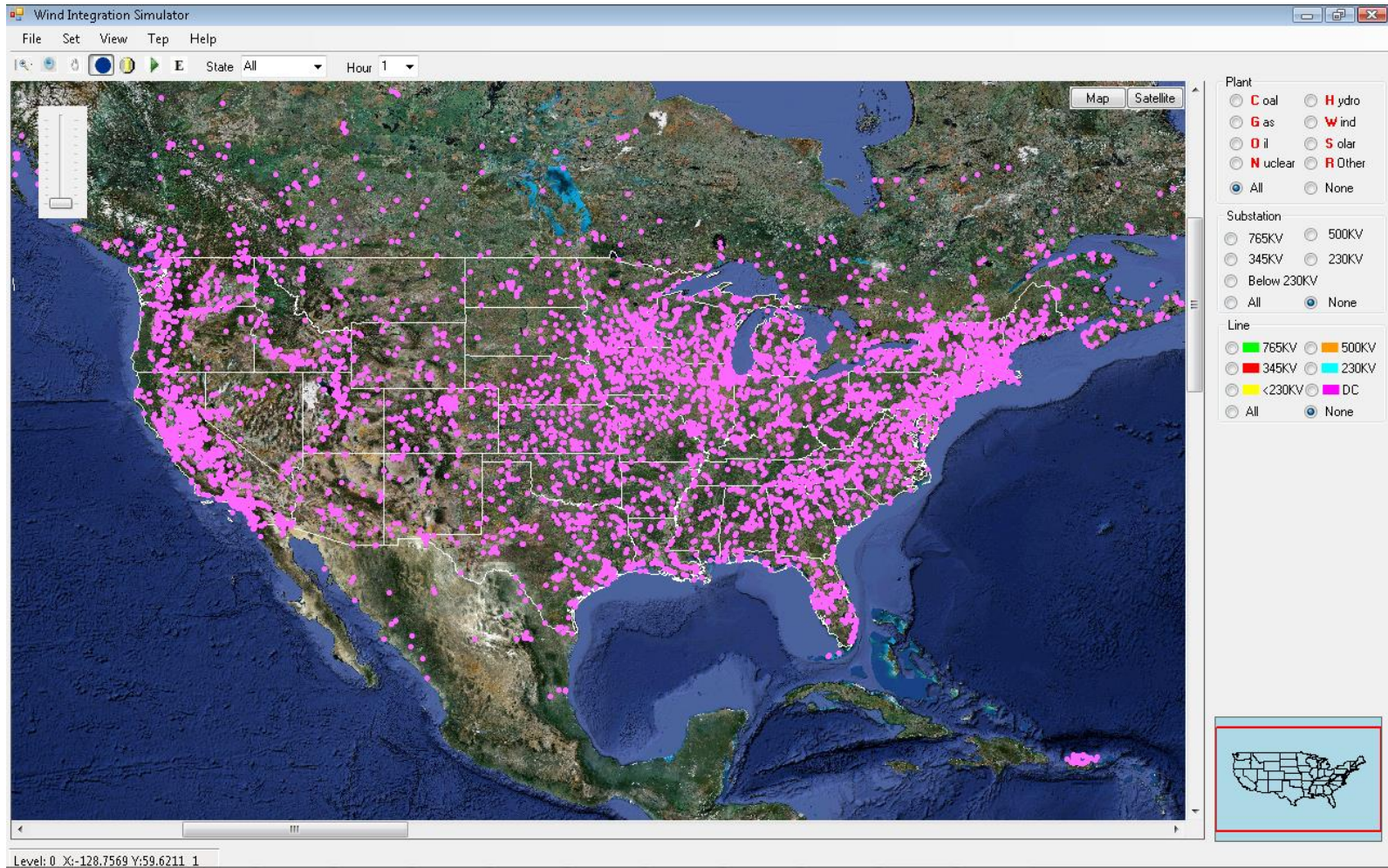
## **Task 7.0 – Advanced Reactive Power and Low-Voltage-Ride-Through Technology**

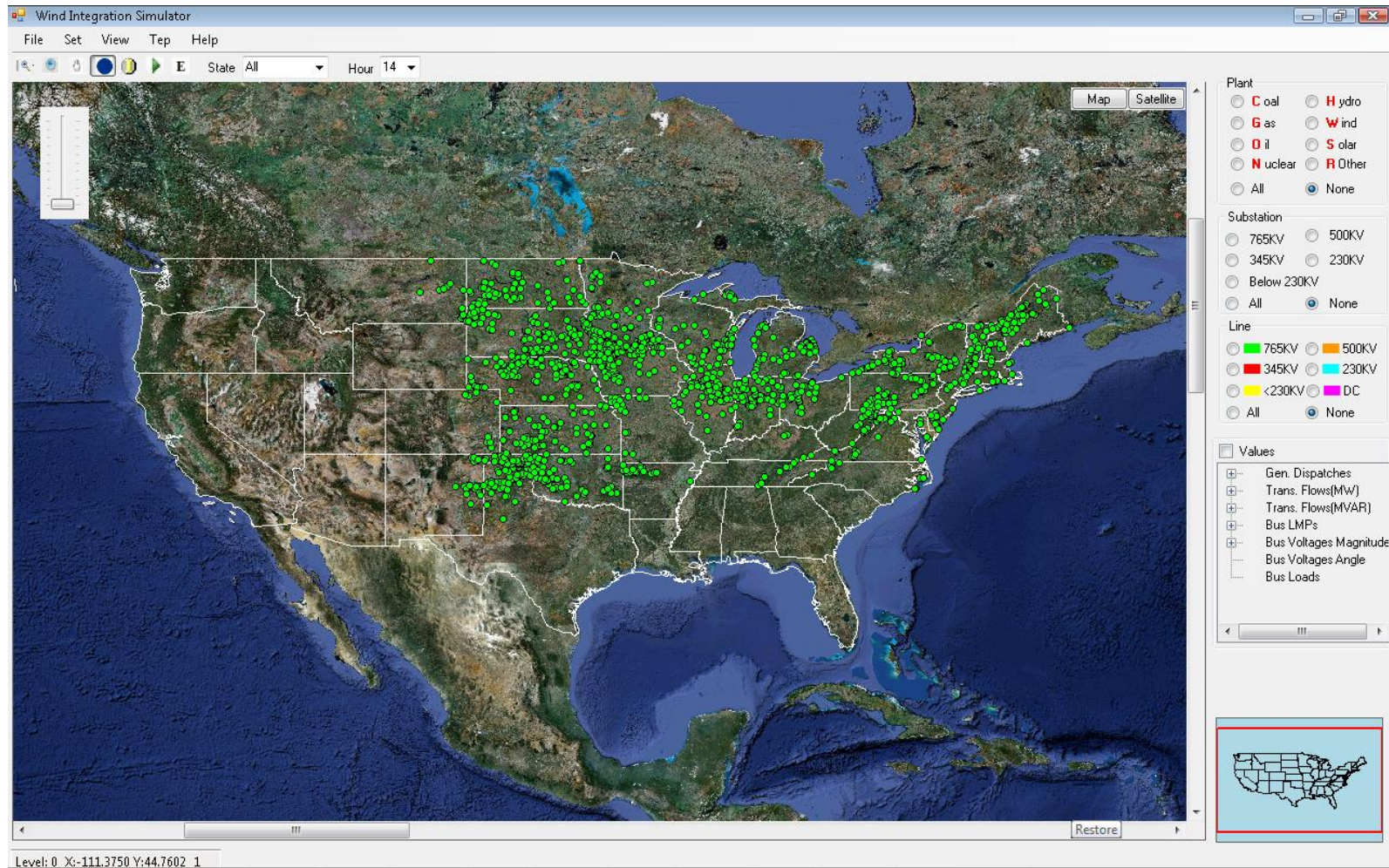
This research will develop a unique reactive power technology that enables a wind turbine to generate reactive power rather than consume reactive power; as well explore Low-Voltage-Ride-Through (LVRT) technology.

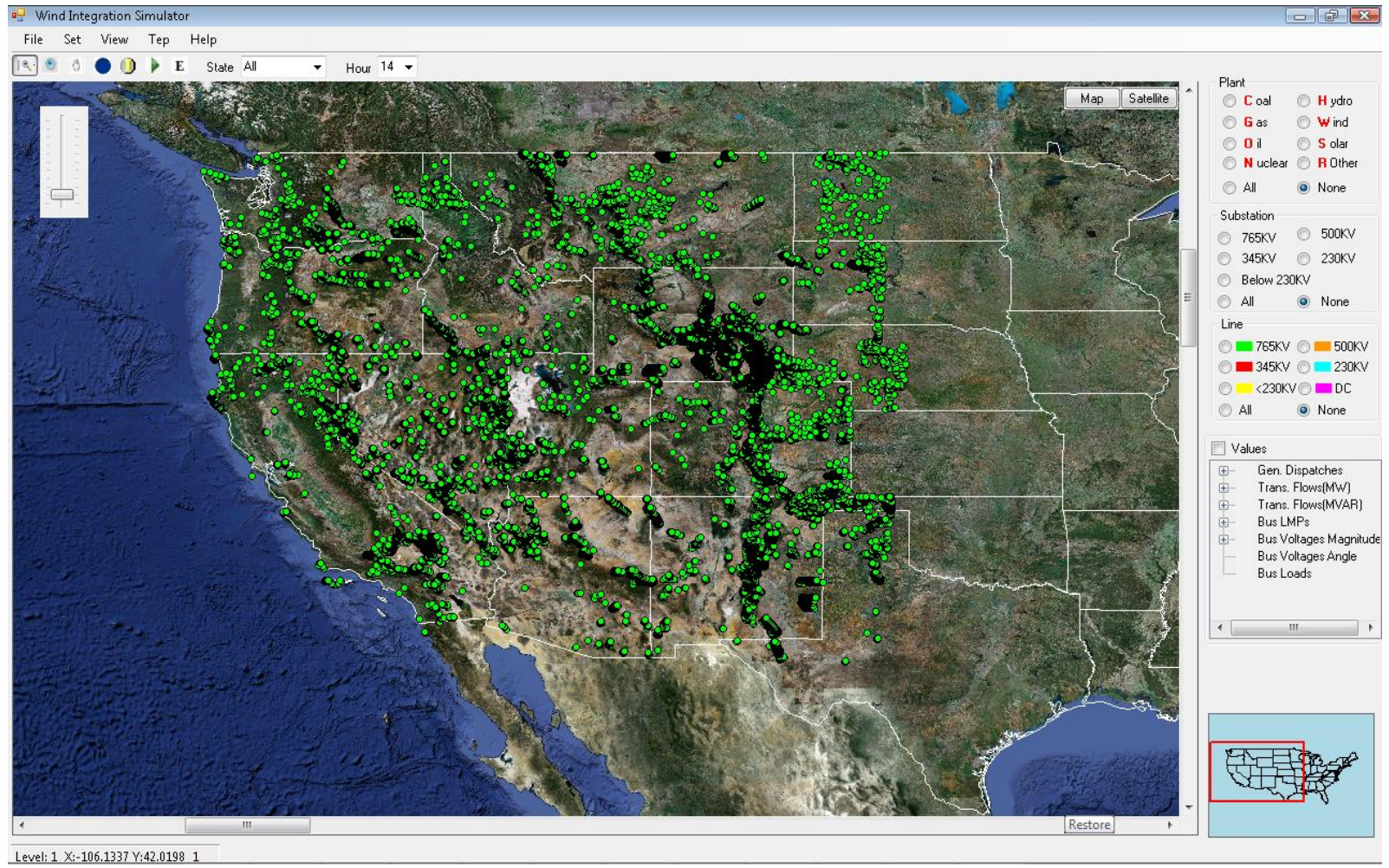
## **Task 8.0 – Advanced Wind Integration Study for Utility-Grade Operation**

- 8.1 Identify Deficiencies in Existing Wind Integration Studies
- 8.2 Operation and Planning Tools for Large Wind Energy Penetration
- 8.3 Energy storage for providing regulating resources
- 8.4 Optimal Mix of Generating Units with High Renewable Penetrations
- 8.5 Market Implications of Wind Power Integration









# Phase III – Wind Energy Research & Development

## Task 9.0 – International Collaboration on Wind Energy Research

Faculty and students from the international university members will be invited to IIT as summer school visitors to share their innovative ideas with their American counterparts, offer short courses and lectures on wind energy to students at IIT, and conduct relevant wind energy research and development in the United States.



# Phase IV – Workforce Development

## **Task 10.0 – Engage Undergraduate Students in Wind Energy Research**

This will include inter-professional (IPRO) courses on such topics as technical design of wind turbines and market integration of wind energy.

## **Task 11.0 – Develop Undergraduate and Graduate Courses and Laboratories on Wind Energy**

The course materials, textbooks, laboratory setups, lab manuals, and power point lecture presentations will be developed and used by participating universities. Such courses include Renewable Energy Technologies, Power System Analysis, and Smart Grid in Electricity Infrastructure.

## [ECE 581 - Elements of Smart Grid](#)

This course covers cross-disciplinary subjects on smart grid that relates to energy generation, transmission, distribution, and delivery as well as theories, technologies, design, policies, and implementation of smart grid. Topics include: smart sensing, communication, and control in energy systems; advanced metering infrastructure; energy management in buildings and home automation; smart grid applications to plug-in vehicles and low-carbon transportation alternatives; cyber and physical security systems; microgrids and distributed energy resources; demand response and real-time pricing; and intelligent and outage management systems.

**Levels:** Graduate Doctoral, Graduate Business,

**Schedule Types:** [Lecture](#)

Electrical & Computer Engineering Department

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# Phase IV – Workforce Development

## **Task 12.0 – Offer Degree Program and Certificates on Wind Energy**

The consortium members will develop academic curricula and industry internships to train the next generation of wind industry employees and entrepreneurs. IIT plans to offer in 2010 the first Internet-based master's degree program in the world on Smart Grid and Sustainable Energy.

## **Task 13.0 – Develop Teaching Materials and Textbooks on Wind Energy**

The following textbooks will be published in which the wind technology methods will be discussed as part of the publication activities of the consortium: Electric Power Operation and Control, and the Application of Stochastic Models to Power Systems.

# Phase V – Project Reporting

## Task 14.0 Project Management and Reporting

- Dr. Mohammad Shahidehpour, who is the Principal Investigator, will coordinate the project phases and the communication with the consortium members and the DOE project managers.
- He will also coordinate the DOE project review meetings as part of this task.
- The consortium members will prepare and submit the periodic, topical, and final reports in accordance with the Federal Assistance Reporting Checklist following the instructions included therein.
- Other than those identified on the Federal Assistance Reporting Checklist, this project will have specific deliverables for each phase and task.

## Fall 2010 Meeting

### A World-Class University-Industry Consortium for Wind Energy Research, Education, and Workforce Development

September 30, 2010

McCormick Tribune Campus Center Ballroom, Illinois Institute of Technology  
3201 S. State Street, Chicago, IL  
[http://www.iit.edu/about/directions\\_main\\_campus.shtml](http://www.iit.edu/about/directions_main_campus.shtml)

Illinois Institute of Technology was awarded an \$8M grant from the U.S. Department of Energy to establish a University-Industry Consortium for Wind Energy Research, Education, and Workforce Development. [http://www.iit.edu/departments/pr/mediaroom/article\\_viewer\\_db.php?articleID=396](http://www.iit.edu/departments/pr/mediaroom/article_viewer_db.php?articleID=396). On September 30, 2010, IIT's Center for Electricity Innovation and Wanger Institute for Sustainable Energy Research (WISER) are hosting the Fall 2010 meeting of the Consortium members on IIT's main campus in Chicago. The schedule for the day is as follows:

8:00-8:30 am	Registration and Introduction
8:30-10:45	Discussion on implementation of the DOE-funded Wind Consortium project
10:45-12:00	Tour of the DOE-funded projects at IIT
12:00-1:00 pm	Lunch
1:00-3:00	Symposium on Future of Wind Power Event
3:00-4:00	Reception

#### MORNING SESSION

The morning session will include presentations by consortium members and discussions of ongoing tasks. The discussions will be followed up by a tour of the DOE-funded projects at IIT.

#### Presentations (8:30-10:15 am)

Mohammad Shahidehpour, IIT  
Frank Bristol, Acciona  
Jim Gagnard, SmartSignal  
Alan Cain, Innovation Technology Applications, and Ganesh Raman, IIT  
Greg Rouse and John Kelly, Intelligent Power Solutions  
Alireza Khaligh, IIT  
Richard Gowen, Dakota Power  
Zuyi Li, IIT  
John Birge, University of Chicago

#### Discussion (10:15-10:45 am)

All Consortium members

#### Tour of the IIT Projects (10:45-12:00 noon)

- **Wind Turbine Installations.** The wind energy consortium tasks include the installation of two 8-kW wind units at IIT for research and education. The first unit already installed in one of the laboratories at IIT will be demonstrated as part of the campus tour.
- **Perfect Power Smart Microgrid.** IIT has been working on a DOE-funded perfect power project since 2008. The project is converting IIT to a microgrid for enhancing reliability, sustainability, and efficiency of its electricity grid. A tabletop model of the campus buildings is developed and a demonstration of the perfect power concept will be presented to the consortium members and guests.

Lunch (12:00 noon-1:00 pm) at McCormick Tribune Campus Center

## Symposium on Wind Energy Research, Education, and Workforce Development

(1:00- 3:00 pm) September 30, 2010

McCormick Tribune Campus Center Ballroom, Illinois Institute of Technology  
3201 S. State Street, Chicago, IL  
[http://www.iit.edu/about/directions\\_main\\_campus.shtml](http://www.iit.edu/about/directions_main_campus.shtml)

The symposium will bring industry and government leaders together to discuss breakthrough technologies, innovations, and implementation developments in the wind industry. The state of the wind energy industry in the United States is facing numerous challenges, from wildlife and zoning concerns to the deficiencies of our nation's electric transmission grid. Yet, the industry is also being presented with new opportunities, from the country's first offshore wind farms, to new smart grid technologies that allow better integration of intermittent power into the grid.

#### Symposium Speakers:

Brian Connor – U.S. Department of Energy  
Sonny Garg – President, Exelon Power & Senior Vice President, Exelon Generation  
Michael Polsky – President/CEO, Invenenergy  
Paul McCoy – President, Trans-Elect  
Kurt Yeager – Former President, EPRI / Executive Director, Galvin Electricity Initiative  
Joshua Milberg - First Deputy Commissioner, City of Chicago Department of Environment

#### Reception (3:00-4:00 pm)



Stuart Field Looking West

