REGIS Workshop Abstracts

A Case for Energy Storage as Part of Hawaii's Power Generation Plan
Dan Borneo

The movement to expand the use and penetration of renewable energy technologies as options for cleaner energy sources directly involves storage. Without a cogent discussion of energy storage as part of the resource planning, both the end-users and electric utilities are faced with questions about reliability and dispatchability. In simple terms, the variability that is associated with wind and Photovoltaic (PV) energy can mean that electric power is available only when the wind is blowing or the sun is shining.

Energy storage allows renewable generating sources to be dispatchable or available when needed. And, in island systems, large penetration of a variable source such as wind energy could introduce electrical instabilities that must be managed (usually through the use of storage). Currently wind and PV use the grid for their storage medium. However, this approach requires that generators be kept running either in stand-by mode or at reduced loads. Neither is an efficient means to operate an electric grid generator. Both methods increase maintenance, CO_2 emissions, and fuel costs.

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Solar Energy Grid Integration Systems "SEGIS" Program
Ward I. Bower and Dan Ton

The inevitable transformation of the electrical grid to a more distributed, intelligent generation and distribution configuration requires grid interconnect methodologies well beyond simple net-metered, grid-connected approaches. New technical requirements combine to necessitate more sophisticated PV system designs that integrate energy management and/or energy storage into intelligent PV systems. This report provides an overview of the "Solar Energy Grid Integration Systems" (SEGIS) program that supports development of new components, advanced innovative inverter/controllers, economical energy management systems, innovative energy storage and a suite of advanced control algorithms, technical methodologies, and protocols associated with communications. Twelve SEGIS contractors are focusing their R&D on solutions for all facets of system optimization and interconnection to intelligent grids of the future while still meeting the "levelized cost of energy" (LCOE) goals of the Solar America Initiative.

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Promises and Challenges of Utility Scale PV Grid Integration
Leo F. Casey, Satcon, Robert F. Johnson, SunPower, Bob Reedy, FSEC

Large PhotoVoltaic systems offer the promise of lower costs of electricity and also simpler control by the Utility. The goal is to make these large scale systems true Utility assets, but there are a number of technical and regulatory hurdles to overcome. The presenters have direct experience with 1-10MW PV systems integrated into the medium voltage distribution network of Utility Grid, including the Lanai PV system. This experience includes work on large grids and also on relatively weak grids where the PV is both a major component and could be regarded as a destabilizing force due to the intermittent nature of the resource. The presentation will cover challenges in integrations, from communicating with SCADA systems, through fault ride-thru requirements in weak grids, and the stabilizing potential of Inverters with some moderate amount of storage.

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Japanese Policies Related to New and Renewable Energy & Grid Integration
Takashi Kawabata

Starting with the "Sunshine Project" in 1974, Japan's Ministry of Economy, Trade and Industry (METI) has been promoting a renewable energy RD&D policy. One component of this policy was providing subsidies for residential PV systems from 1993 to 2005, allowing the creation of a PV market, and thereby facilitating a decrease in system

costs. Last year, Japan's cabinet set an "Action Plan for Achieving a Low-Carbon Society" that calls for a ten-fold increase in PV capacity by 2020, and a 40-fold increase by 2030. The past experience, current situation and the future forecasts laid out in Japan's policy for promoting the use of renewable energy sources will be introduced in this presentation.

This rapid or widespread installation of renewable energy systems promoted by Japan may, however, have a negative impact on electricity grids, including the destabilization of voltages and/or frequencies. Because Japanese grid capacity is rather small compared with Europe or the US, measures to stabilize the grids and address the cost burden are under consideration in Japan. In this presentation, the state of Japan's electric grid system and some analysis of options for grid stabilization measures will be addressed from the technological and policy perspectives.

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The particularity of the power network incorporating with the aggregation of distributed PV systems
Kosuke Kurokawa

Japan set up the long-term R&D roadmap called "PV2030" in June 2004. Its accelerated scenario is assuming that the mass deployment of 100GW PV aggregation will supply 10 % of national electricity up to year 2030. Around a half of this PV installation will be fulfilled by residential rooftop applications. In such a state, PV penetration will reach 100 % or more in the majority of urban areas and might become less harmonized with the conventional power grid approach due to frequent and apparently high-level reversal power flow from PVs to upstream grids. The author proposes a new concept to realize a less dependent PV aggregation on the existing power grids by adding power electronics and energy storages, which is named "autonomy-enhanced PV clusters" (AE-PVC). Early results have already been obtained including conceptual definitions of autonomy-enhanced, community-base clustered PV systems.

He will also add another approach of Very Large Scale Photovoltaic Power Generation (VLS-PV) Systems on deserts, ranging from ten mega watts to giga watts scale. Nowadays, it is not a simple dream story but becomes very realistic. The third volume of "Energy from the Deserts" is to be published soon, in which more practical case are studied over the world deserts such as the Mediterranean region, the Middle East, Asia and Oceania as well as global deployment scenario toward world major energy source up to 2100 including a vision of global network infrastructure.

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Battery Storage Applications for Integration of Renewable Energy
Satoshi Morozumi

As the application of stationary batteries and other energy storage technologies to power grids has been a focus in Japan since the 1970s, the history of battery technology development in Japan and the changing application for these technologies will initially be discussed. With the increased awareness of the serious threat of climate change, power generated from renewable energy sources is being viewed as an important countermeasure. However, because power output from PV and wind power fluctuates and produces a negative impact on power grids, NEDO has been focusing on several energy storage applications for renewable energy and has promoted several demonstration projects since 2000.

In fiscal year 2007, four major demonstration projects, "Demonstrative Project of Regional Power Grids with Various New Energies," "Demonstrative Project on Grid-interconnection of Clustered Photovoltaic Power Generation Systems," "Wind Power Stabilization Technology Development Project" and "Demonstrative Project on New Power Network Systems," were completed. Another demonstration project, "Verification of Grid Stabilization with Large-scale PV Power Generation Systems," is ongoing. The results of these demonstration projects and the progress made towards harmonizing renewable energy connected to grids will be presented.

Lastly, NEDO commenced a technology development project in 2006 to develop cheaper, longer-life battery technologies for the future that can reduce renewable energy output fluctuations. The targets of this development project are also introduced.

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NEDO Research Related to Large-scale PV-related Grid-connection Projects
Hirofumi Nakama

NEDO is Japan's largest public R&D management organization for promoting the development of advanced industrial, environmental, new energy and energy conservation technologies. One of the important objectives of NEDO's R&D is solving problems that arise when distributed and renewable resources are connected to power grids. An overview of grid-connection-related demonstrative projects of the New Energy and Industrial Technology Development Organization (NEDO) is introduced in this presentation.

The presentation will focus on recent topics related to two large-scale PV demonstration projects: "Demonstrative Project on Grid-Interconnection of Clustered Photovoltaic Power Generation Systems" and "Verification of Grid Stabilization with large-scale PV Power Generation Systems." In the first project, grid connection technologies for a mega solar system are being studied. The focus of the second project is voltage control technology and a new islanding detection system for clustered PV systems.

Also, results of a pre-feasibility study of future network technologies, in anticipation of the widespread installation of renewable energy systems, will be discussed in the latter part of the presentation. Through this study, we identified the potential for the rapid penetration of PV systems and future problems, such as the challenge of controlling voltages, the instability of the main grid and the imbalance of demand and supply, which our grid systems will need to address in the future.

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REGIS Workshop Abstract

Grid Integration of Wind Power in New Zealand
David F. S. Natusch

New Zealand is fortunate in having a large and reliable wind resource and the use of Wind Power is growing very rapidly. This paper describes the New Zealand Electricity supply system and notes that more than 70% of current electricity supply is generated from renewable resources. About 3% is currently generated from Wind Power.

Integration of Wind Power into the grid is somewhat easier in New Zealand than in other countries due to the reliability of the wind resource, proximity to the grid, the availability of large amounts of rapidly switchable electricity and the existence of electricity supply, reserve and frequency keeping markets that can provide whole-system support. While all of the technical solutions for minimizing and utilizing VARs are deployed in New Zealand, most grid integration problems are addressed primarily through market mechanisms.

System analyses indicate that the current facilities for Wind Power integration in New Zealand would enable about 35% market penetration without the introduction of additional infrastructure.

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REGIS Workshop Abstract

Renewable Energy Grids Over Time
Juan Torres

To facilitate more extensive adoption of renewable distributed electric generation, the U.S. Department of Energy launched the Renewable Systems Interconnection (RSI) study during the spring of 2007. The study addressed the technical and analytical challenges that must be addressed to enable high penetration levels of distributed renewable energy technologies. This RSI study addresses grid-integration issues as a necessary prerequisite for the long-term viability of the distributed renewable energy industry, in general, and the distributed PV industry, in particular.