BACKGROUND

State EE/RE Technical Forum
Call #13: Distributed Generation and Combined Heat and Power Interconnection
February 9, 2006, 2:00 – 3:30 pm EST

I. Background

Many states are interested in expanding the use of clean distributed generation (DG)[1] projects. The benefits of increasing the number of clean DG projects include:

- Enhancing economic development in the state by facilitating investment in new and existing DG facilities that contribute to meeting electricity demand in the state;
- Reducing peak electrical demand - potentially deferring or displacing more expensive transmission and distribution infrastructure investments;
- Reducing electric grid constraints - the application of DG in targeted load pockets can reduce grid congestion;[2]
- Reducing the environmental impact of power generation – as clean DG displaces higher emission sources; and
- Helping states achieve success with renewable portfolio standards and other clean energy initiatives.

One hurdle for expanding the use of DG is that customers seeking to interconnect DG projects to the utility grid must meet the procedural and technical requirements of the local utility company. These requirements address such important issues as grid stability and worker and public safety. With the approval of state utility regulators, utilities establish the conditions that customers seeking to connect DG systems to the grid must meet. These conditions include safeguards, grid upgrades, operating restrictions, fees, rate structures, and application procedures that may create barriers for some DG projects, particularly smaller systems.

State utility commissions, in determining utility interconnection rules, can establish uniform application processes and technical requirements that reduce uncertainty and prevent

[1] Clean distributed generation encompasses renewable energy and combined heat and power (CHP). CHP is the simultaneous generation of electric and thermal energy from a single fuel source. Unless otherwise stated, clean DG does not include large wind projects or large merchant CHP plants, since the interconnection issues these projects face are similar to central station power generators. For more information on combined heat and power, see: http://www.epa.gov/chp/what_is_chp.htm.

[2] For information about a 2005 California Energy Commission showing that strategically sited DG yields improvements to grid system efficiency and provides additional reserve power, deferred costs, and other grid benefits, see: Evans, P.B. 2005. Optimal Portfolio Methodology for Assessing Distributed Energy Resources Benefits for the Energynet. http://www.energy.ca.gov/2005publications/CEC-500-2005-061/CEC-500-2005-061-D.PDF.

excessive time delays and costs that DG, including combined heat and power (CHP), can encounter when obtaining approval for electric grid connection.

The Energy Policy Act of 2005 (EPAct 2005), signed into law on August 8, 2005, sections 1251, 1252, and 1254 amend the Public Utility Regulatory Policies Act of 1978 (PURPA) and have important implications for state interconnection regulations. These sections pertain to net metering, smart metering, and interconnection requirements, respectively. Specifically, EPAct 2005 directs states to consider upgrading their standards for interconnecting small generators within one year of enactment, and consider their net metering standards within two years of enactment. Smart metering is mentioned here because it deals with awareness of variance in wholesale electricity generation cost and loads and could play a role in decisions about when to use onsite generation and how much. (See section V.C of this paper for the initial paragraphs of sections 1251, 1252, and 1254.)

States consider a number of key factors when designing effective interconnection standards that balance the needs of DG owners, the utility company, and the public. These factors include promoting broad participation during standards development, addressing a range of technology types and sizes, and taking into consideration current barriers to interconnection. In addition, it is important to consider state and federal policies that might influence the development and operation of interconnection standards.

Interconnection standards to promote DG typically specify:

- The type of DG technology that may be interconnected (e.g., inverter-based systems, induction generators, synchronous generators);

- The required attributes of the electric grid where the system will be interconnected (e.g., radial or network distribution, distribution or transmission level, maximum aggregate DG capacity on a circuit); and

- The maximum system size that will be considered in the standard interconnection process.

Standard interconnection rules also typically address the application process and the technical interconnection requirements for DG projects:

- The *application process* includes some or all parts of the interconnection process from the time a potential customer considers submitting an application to the time the interconnection agreement is finalized. For example, rules may specify application forms, timelines, fees, dispute resolution processes, insurance requirements, and interconnection agreements.

- Standard interconnection rules also address *technical protocols and standards* that specify how a generator must interconnect with the electric grid. For example, requirements may specify that DG must conform to industry or national standards (such as IEEE 1547 and UL 1741) and include protection systems designed to minimize degradation of grid reliability and performance and maintain worker and public safety.

In addition, some states are developing different application processes and technical requirements for differently sized or certified systems. Since the size of a DG system can range from a renewable system of only a few kW to a CHP system of tens of MW, standards can be designed to accommodate this full range. Several states have developed a multi-tiered process for systems that range in size from less than 10 kW to more than 2 MW. Three states (Connecticut, Michigan, and Minnesota) have classified DG systems into five categories based on generator size. Other states use fewer categories, but also define fees, insurance requirements, and processing times based on the category into which the DG falls. The level of technical review and interconnection requirements usually increases with generation capacity.

Key stakeholders who can contribute to the process of developing effective interconnection standards include:

- Electric utilities;
- State public utility commissions (PUCs);
- Developers of CHP and renewable energy systems and their respective trade organizations;
- Third-party technical organizations such as the Institute of Electrical and Electronic Engineers (IEEE) and certifying organizations like the Underwriters Laboratory (UL);
- Regional transmission organizations (RTOs); and
- Other government agencies. Federal agencies and state environmental and public policy agencies can play an important role in establishing and developing interconnection standards.

II. State Programs

As of November 2005, 13 states had adopted standard interconnection requirements for distributed generators (California, Connecticut, Delaware, Hawaii, Massachusetts, Michigan, Minnesota, New Mexico, New Jersey, New York, Ohio, Texas and Wisconsin), and eight additional states were in the process of developing similar standards (Arizona, Illinois, Iowa, Indiana, North Carolina, Pennsylvania, Vermont, and Washington).

In addition to interconnection requirements, many states have adopted net metering provisions. Most states find that smaller DG systems are more likely to produce power primarily for their own use, with exports to the grid tending to be incidental. Net metering provisions can be considered a subset of interconnection standards for small scale projects that is applicable when DG output exceeds the site's electrical needs. With net metering, the utility pays the customer for excess power supplied to the grid or carries the net surplus carry over to the next month's bill. Some states allow the surplus account to be reset periodically, meaning that customers might provide some generation to the utility for free. As of early 2005, 39 states and the District of Columbia had rules or provisions for net metering. Net metering provisions streamline interconnection standards but often are limited to specified sizes and types of technologies.

A. California

In 1999, California issued order 99-10-025 to institute a new rulemaking for the interconnection of distributed energy resources. In 2000, the California Energy Commission (CEC) adopted the Rule 21 interconnection standard and the three major utilities regulated by the California Public Utility Commission have since adopted the Rule 21 model tariff, interconnection application form, and interconnection agreement. Those utilities include Pacific Gas and Electric Company, San Diego Gas and Electric Company, and Southern California Edison. Several California municipal utilities, including City of Palo Alto Utilities, have also adopted similar interconnection rules.

In 2003, the CEC published a guide to assist DG projects with interconnection under Rule 21. The guide provides information resources for each step in the regulatory process. Further guidance has addressed specific elements of Rule 21 as it pertains to smaller generating systems. Most recently, these revisions included lessons learned from utilities, system integrators, and distributed resource developers with interconnection applications that failed an initial review process under Rule 21 and went on to supplemental review. The guidance offers a consistent procedure for engineers to apply the review process and a primer on the review process for distributed resource providers. California has sought to coordinate their revisions to interconnection process guidance with development of IEEE Standard 1547.6, interconnection research in Massachusetts, and other related efforts.

B. Massachusetts

In June 2002, the Massachusetts Department of Telecommunications and Energy (DTE) initiated a rulemaking to develop interconnection standards for DG. DTE established a DG Collaborative to engage stakeholders (including utilities, DG developers, customers, and public interest organizations) to jointly develop a Model Interconnection Tariff.

By adopting this Model Interconnection Tariff, Massachusetts established a clear, transparent, and standard process for DG interconnection applications. The process uses pre-specified criteria to screen applications and establish application fees and timelines for DG systems of all types and sizes. The Model Interconnection Tariff clearly specifies each step within the interconnection process and the maximum permissible time frames for each step. In addition, the Model Interconnection Tariff provides for a "Simplified Process" that allows most inverter-based systems that are 10 kW or less and are UL 1741 certified to be processed in less than 15 days without an application fee. Under the "Standard Process," used for larger DG systems that may have significant utility system impact, the process can take as long as 150 days and involve a $2,500 application fee, in addition to other technical study and interconnection costs. The DG Collaborative also agreed to a five-step dispute resolution process in the event the interconnecting applicant is unable to reach agreement with the utility regarding the utility's decisions on the interconnection application.

After the adoption of the Model Interconnection Tariff, the DG Collaborative reconvened to evaluate the reasonableness of the interconnection process by reviewing how the standard was functioning. The DG Collaborative examined application fees and time frames through a database structured to track interconnection applications. Although many applicants have

successfully used the existing standard, the DG Collaborative has determined that it should review the application process and screening criteria in the Model Interconnection Tariffs to further improve the process. This level of review is unique among states that have developed interconnection standards.

C. New Jersey

The New Jersey Board of Public Utilities has developed net metering and interconnection standards for class I renewable energy systems. These rules became effective on October 4, 2004, and are separated into three levels. Each level has specific interconnection review procedures and timelines for each step in the review process.

- Level 1 applies to inverter-based customer-generator facilities, which have a power rating of 10 kW or less and are certified as complying with IEEE 1547 and UL 1741.

- Level 2 applies to customer-generator facilities with a power rating of 2 MW or less and are certified as complying with IEEE 1547 and UL 1741.

- Level 3 applies to customer-generator facilities with a power rating of 2 MW or less that do not qualify for Level 1 or Level 2 review.

D. New York

New York enacted standard interconnection requirements for DG systems in December 1999. The initial requirements were limited to DG systems rated up to 300 kW connected to radial distribution systems. New York recently modified these interconnection requirements to include interconnection to radial and secondary network distribution systems for DG with capacities up to 2 MW.

New York's Standard Interconnection Requirements include a detailed 11-step process from the "Initial Communication from the Potential Applicant" to the "Final Acceptance and Utility Cost Reconciliation." Similar to other states with interconnection standards, New York includes separate requirements for synchronous generators, induction generators, and inverters. Notably, there is no application fee for DG systems rated up to 15 kW. For DG larger than 15 kW, the application fee is $350.00.

E. Texas

In November 1999, the Texas Public Utility Commission adopted substantive rules that apply to interconnecting generation facilities of 10 MW or less to distribution-level voltages at the point of common coupling. This ruling applies to both radial and secondary network systems.

The rules require that Texas utilities evaluate applications based on pre-specified screening criteria, including equipment size and the relative size of the DG system to feeder load. These rules are intended to streamline the interconnection process for applicants, particularly those with smaller devices and for those that are likely to have minimal impact on the electric utility grid. For example, under certain conditions, if the DG interconnection application passes

pre-specified screens, the utility does not charge the applicant a fee for a technical study. If the DG system is pre-certified, the utility has up to four weeks to return an approved interconnection agreement to the applicant. Otherwise, the utility has up to six weeks.

III. Regional and National Programs

Various entities have developed model interconnection rules which states can adopt or use as a basis for their rule:

- NARUC adopted the Model Interconnection Procedures and Agreement for Small Distributed Generation Resources.

- The Mid-Atlantic Distributed Resources Initiative (MADRI) has developed a model rule for interconnection, Model Small Generator Interconnection Procedures.

- The Interstate Renewable Energy Council (IREC) has prepared a model interconnection rule and guide to connecting DG to the grid.

- FERC has standardized interconnection agreements and procedures for large and small generators.

IV. Questions for Discussion

- What are the primary policy drivers for implementing standard interconnection rules and policies for DG in your state?

- What factors did you consider in setting standards, e.g., standardized fees, technical and safety criteria, streamlined process, size thresholds, incentives for clean DG?

- Has your state attempted to quantify the actual or potential benefits of uniform interconnection standards for DG?

- What challenges did you face and what additional technical assistance would be helpful?

V. Resources

A. State Resources

(1) California

- **California's Distributed Energy Resources Guide**: Online information about distributed energy resources and California programs. http://www.energy.ca.gov/distgen/

- **California Interconnection Guidebook**: A Guide to interconnecting customer-owned electric generation equipment to the electric utility distribution system using California's Electric Rule 21.

http://www.energy.ca.gov/distgen/interconnection/guide_book.html

- **CPUC Decision 00-12-037-Decision Adopting Interconnection Standards**: Details on the December 21, 2000, CPUC decision that approved the Rule 21 language adopted by the California Energy Commission, as well as the Model Tariff, Interconnection Application Form, and Interconnection Agreement adopted by the state's primary, investor-owned utilities. http://www.cpuc.ca.gov/word_pdf/final_decision/4117.pdf

- **California Electric Rule 21 Supplemental Review Guideline**: Supports the standardized implementation of interconnection requirements defined in the California Electric Rule 21 with additional guidance. http://www.energy.ca.gov/distgen/interconnection/SUP_REV_GUIDELINE_20050831.pdf

(2) Massachusetts

- **Commonwealth of Massachusetts Department of Telecommunications and Energy (DTE) Proceedings**: Includes DTE's investigation of distributed generation interconnection and the ensuing establishment of a Model Interconnection Tariff. http://www.mass.gov/dte/restruct/competition/distributed_generation.htm

(3) New Jersey

- **Net Metering and Interconnection Standards for Class I Renewable Energy Systems**: Net metering and interconnection requirements for electric power suppliers, basic generation service providers, and electric distribution companies whose residential or small commercial customers generate electricity using Class I[3] renewable energy. http://www.state.nj.us/bpu/wwwroot/secretary/NetMeteringInterconnectionRules. pdf

(4) New York

NY Public Service Commission - Distributed Generation Information: Includes standard interconnection requirements, equipment certification, standby rates, and other related information. http://www.dps.state.ny.us/distgen.htm

(5) Texas

Public Utility Commission of Texas Distributed Generation Interconnection Manual: Guidance on incorporating distributed generation into the grid, directed towards both utility engineers who process DG interconnection applications and those connecting DG - covers most important issues or problems, including a

3 For information on Class 1 renewable energy resources in New Jersey, see: www.state.nj.us/bpu/cleanEnergy/cleanEnergyProg.shtml.

process for prompt dispute resolution.
http://www.puc.state.tx.us/electric/business/dg/dgmanual.pdf

B. Other Resources

(1) EPA's Combined Heat and Power Partnership

The CHP Partnership is a voluntary program that seeks to reduce the environmental impact of power generation by promoting the use of CHP. The Partnership works closely with energy users, the CHP industry, state and local governments, and other stakeholders to support the development of new projects and promote their energy, environmental, and economic benefits.
http://www.epa.gov/chp

(2) Database of State Incentives for Renewable Energy (DSIRE)

Offers a chart of state rules, regulations, and policies including public benefits funds, renewables portfolio standards, net metering, interconnection standards, extension analysis, generation disclosure, contractor licensing, equipment certification, solar/wind access laws, construction and design standards, and green power requirements; buttons on the chart are linked to brief descriptions of the state policy.
http://www.dsireusa.org/summarytables/reg1.cfm?&CurrentPageID=7

(3) DOE - Energy Efficiency and Renewable Energy (EERE)

Links to information on state regulations addressing interconnection regulations.
http://www.eere.energy.gov/de/state_reg_activities.html

(4) DOE – National Renewable Energy Laboratory (NREL) Electric Infrastructure Systems R&D

Provides information on distributed energy testing and certification, interconnection standards and codes, interconnection and control technologies, energy management and grid support applications, and distributed energy regulatory and institutional issues.
http://www.nrel.gov/eis

(5) DOE - NREL Interconnection Standards and Codes

Focuses on uniform interconnection standards as the foundation of future widespread and inexpensive integration of distributed power systems.
http://www.nrel.gov/eis/standards_codes.html

(6) FERC Standardization of Small Generator Interconnection Agreements and Procedures - 18 CFR Part 35 (Issued May 12, 2005)

Federal Energy Regulatory Commission amendments to regulations under the Federal Power Act, requiring public utilities that engage in interstate commerce to amend their tariffs to include standard generator interconnection procedures for generators with no more than 20 megawatts of capacity.
http://www.ferc.gov/EventCalendar/Files/20050512110357-order2006.pdf

(7) IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems

Establishes criteria and requirements for interconnection of distributed resources with electric power systems and provides a uniform standard with requirements relevant to the performance, operation, testing, safety considerations, and maintenance of the interconnection.
http://grouper.ieee.org/groups/scc21/1547/1547_index.html

(8) IEEE P1547.6 Draft Recommended Practice For Interconnecting Distributed Resources With Electric Power Systems Distribution Secondary Networks

This standard builds upon IEEE Standard 1547 for the interconnection of distributed resources (DR) to distribution secondary network systems. This standard establishes recommended criteria, requirements and tests, and provides guidance for interconnection of distribution secondary network system types of area electric power systems (Area EPS) with distributed resources (DR) providing electric power generation in local electric power systems (Local EPS).
http://standards.ieee.org/announcements/pr_secondary_network_power.html

(9) Interstate Renewable Energy Council (IREC) State and Utility Net-Metering Rules

News on state efforts to enable renewable energy connection to utility grids
http://www.irecusa.org/connect

(10) IREC Connecting to the Grid: A Guide to Distributed Generation Interconnection Issues

Addresses interconnection issues relevant to all DG technologies, including renewables, fuel cells, microturbines, and reciprocating engines. Covers sub-kilowatt residential PV systems up to multi-MW combined heat and power systems.
http://www.irecusa.org/pdf/guide.pdf

(11) IREC Technical Interconnection Standards and Procedures for Small-Generator Facilities

Includes equipment certification, application, agreements, and dispute resolution for interconnection of generators from 10 kW up to 10 MW. Draws on and cites the NARUC standard-form interconnection agreement and FERC Order 2006 standard contract as modified by the Mid-Atlantic Distributed Resources Initiative (MADRI).

http://www.irecusa.org/connect/model_interconnection_rule.pdf

(12) MADRI Model Small Generator Interconnection Procedures

A model intended to foster consistency in small generator interconnection rules and practices among MADRI jurisdictions, based on a consensus within the MADRI leadership that DG owners and developers should not have to face a process that demands excessive time or resources, and that operators of distribution systems should not compromise system reliability or safety while adapting their operating and management practices to promote, advance and enable DG.
http://www.energetics.com/MADRI/interconnection.html

(13) NARUC Model Interconnection Procedures and Agreement for Small Distributed Generation Resources

Includes a model interconnection agreement and procedures with an explanation of the policy decisions required for individual State adoption of the model and examples of how other States have solved the policy issues.
http://www.naruc.org/associations/1773/files/dgiaip_oct03.pdf

(14) Regulatory Requirements Database for Small Electric Generators

The Energy Environment and Analysis, Inc. database, of regulations for small generators offers state by state information about permit requirements, exit fees, standby rates, economic incentives, emissions regulations, siting regulations, and regulatory codes. Developed for US DOE and Oak Ridge National Laboratory.
http://www.eea-inc.com/rrdb/DGRegProject/index.html

(15) UL Standard 1741

Provides design standards for inverter-based systems under 10 MW, combining product safety requirements with the utility interconnection requirements developed in the IEEE 1547 Standard. Covers inverters, converters, charge controllers, and interconnection system equipment.
http://ulstandardsinfonet.ul.com/scopes/1741.html

C. Energy Policy Act of 2005

The initial paragraphs of sections 1251, 1252, and 1254 of the Energy Policy Act of 2005 are quoted below.

SEC. 1251. NET METERING AND ADDITIONAL STANDARDS.

Adoption of Standards.--Section 111(d) of the Public Utility Regulatory Policies Act of 1978 (16 U.S.C. 2621(d)) is amended by adding at the end the following:

"(11) Net metering.--Each electric utility shall make available upon request net metering service to any electric consumer that the electric utility serves. For purposes of this

paragraph, the term 'net metering service' means service to an electric consumer under which electric energy generated by that electric consumer from an eligible on-site generating facility and delivered to the local distribution facilities may be used to offset electric energy provided by the electric utility to the electric consumer during the applicable billing period."

‘‘(3)(A) Not later than 2 years after the enactment of this paragraph, each State regulatory authority (with respect to each electric utility for which it has ratemaking authority) and each nonregulated electric utility shall commence the consideration referred to in section 111, or set a hearing date for such consideration, with respect to each standard established by paragraphs (11) through (13) of section 111(d).‘‘

“(B) Not later than 3 years after the date of the enactment of this paragraph, each State regulatory authority (with respect to each electric utility for which it has rate making authority), and each nonregulated electric utility, shall complete the consideration, and shall make the determination, referred to in section 111 with respect to each standard established by paragraphs (11) through (13) of section 111(d).’’

SEC. 1252. SMART METERING.

In General.--Section 111(d) of the Public Utility Regulatory Policies Act of 1978 (16 U.S.C. 2621(d)) is amended by adding at the end the following:

"(14) Time-based metering and communications.--(A) Not later than 18 months after the date of enactment of this paragraph, each electric utility shall offer each of its customer classes, and provide individual customers upon customer request, a time-based rate schedule under which the rate charged by the electric utility varies during different time periods and reflects the variance, if any, in the utility's costs of generating and purchasing electricity at the wholesale level. The time-based rate schedule shall enable the electric consumer to manage energy use and cost through advanced metering and communications technology."

SEC. 1254. INTERCONNECTION.

Adoption of Standards.--Section 111(d) of the Public Utility Regulatory Policies Act of 1978 (16 U.S.C. 2621(d)) is amended by adding at the end the following:

"(15) Interconnection.--Each electric utility shall make available, upon request, interconnection service to any electric consumer that the electric utility serves. For purposes of this paragraph, the term 'interconnection service' means service to an electric consumer under which an on-site generating facility on the consumer's premises shall be connected to the local distribution facilities. Interconnection services shall be offered based upon the standards developed by the Institute of Electrical and Electronics Engineers: IEEE Standard 1547 for Interconnecting Distributed Resources with Electric Power Systems, as they may be amended from time to time. In addition, agreements and procedures shall be established whereby the services are offered shall promote current best practices of interconnection for distributed generation, including but not limited to practices stipulated in model codes adopted by associations of state regulatory agencies. All such agreements and procedures shall be just and reasonable, and not unduly discriminatory or preferential."

“5)(A) Not later than 1 year after the enactment of this paragraph, each State regulatory authority (with respect to each electric utility for which it has ratemaking authority) and each nonregulated utility shall commence the consideration referred to in section 111, or set a hearing date for consideration, with respect to the standard established by paragraph (15) of section 111(d).”

“B) Not later than two years after the date of the enactment of the this paragraph, each State regulatory authority (with respect to each electric utility for which it has ratemaking authority), and each nonregulated electric utility, shall complete the consideration, and shall make the determination, referred to in section 111 with respect to each standard established by paragraph (15) of section 111(d).'.”