A Utility Perspective on the New Massachusetts DG Interconnection Tariff

(Summary of a panel session presentation)

John J. Bzura, Ph.D., P.E., *Senior Member, IEEE*

***Abstract* – In recent years, several state utility regulatory agencies have mandated creation of simplified policies and procedures for interconnection of customer-owned distributed generation (DG) to the utility distribution system (the "grid"). The primary focus of these efforts has been relatively small generating units (kW-scale) designed for residential or commercial sites. This paper will report on the new DG tariff in Massachusetts, which was created via a collaborative process involving utilities, DG suppliers, utility customers, public interest groups and other interested stakeholders over a two-year period. The tariff builds upon work done in California and New York as well as DG tariff development undertaken by the U.S. Federal Energy Regulatory Commission (FERC).**

Finally, this paper is a preview of material to be presented at the conference. The presentation will cover the topics noted here along with comments on experience with the tariff and plans for additional work by the ongoing DG tariff collaborative.

***Keywords* - Distributed generation; DG; radial system; screening criteria; interconnection; spot network system.**

I. INTRODUCTION

The concept of distributed generation (DG) may be defined as employing large numbers of relatively small generating units (kW to MW), distributed either widely through an area served by a typical substation (40 MW in the U.S.) or relatively concentrated in the commercial or industrial areas served by the substation. This is in contrast to the widespread current practice of using large (200 MW to 2 GW) centralized power plants and a network of transmission lines to carry power to substations, which provide power to customers over conventional distribution systems.

Proponents of implementing the DG concept claim several benefits over the current central-station model, most notably (a) reduced need for upgrading substation capacity in areas of load growth, (b) higher energy conversion efficiency if cogeneration [also known as CHP, for combined heat and power] is employed as part of each DG installation, (c) reduction of kWh losses on the distribution and transmission systems and (d) a power system more resistant to sabotage.

The first two claims are quite dependent upon the type of DG proposed (e.g., microturbine versus wind turbine, diesel cogen versus a solar PV system, etc.), how the DG units would be operated, the reliability of these DG units and [for (a)] local conditions in the area served by the substation. Claims (c) and (d) are generally true, but the level of improvement in each case is subject to the range and quality of assumptions employed for each concept.

Nevertheless, for these and other pro-DG reasons, the states of California, Texas, New York and Massachusetts began utility regulatory activities to both ***simplify*** the DG interconnection process (particularly for smaller DG systems likely to be installed on residences) and ***standardize*** the process for all investor-owned utilities in each state. Massachusetts (MA) and New York (NY) established completely new or updated DG tariffs in 2004, building upon prior tariffs and then incorporating what were considered to be desirable features of DG tariffs from other states. The new MA interconnection tariff is the subject of this paper.

II. MASSACHUSETTS DG TARIFF OVERVIEW

A key feature of this tariff is that there are three types of DG interconnection processes, designed expressly to create a very straightforward and expeditious procedure as one of the options for the most common residential DG applications: solar photovoltaic (PV) systems or wind turbine energy systems, with inverter output and a maximum capacity of 10 kW. The three process options are shown in Figure 1 on the following page.

The ***Simplified*** process was created for the common types of DG noted above, and in fact applies to commercial, institutional or industrial sites as well – if maximum system capacity is 10 kW. The three criteria for interconnection approval are as follows.

1. <u>*Is the customer served by a radial distribution system?*</u> Most customers are, but this question helps to identify those who are *not* and therefore served by a **network** distribution system which requires a separate and individual utility study.

2. <u>*Would the capacity (kW) of the proposed DG unit, in combination with other DG units approved previously on the specific supplying circuit, exceed a limit of 7.5% of the circuit annual peak load?*</u> This is a future-oriented criterion, established to ensure that a high concentration of DG on a feeder (distribution circuit) would not cause power quality problems for customers or operational problems for the utility. No DG application to date has come close to the limit.

J. J. Bzura is with National Grid USA, Northborough, MA 01532. E-mail: John.Bzura@us.ngrid.com

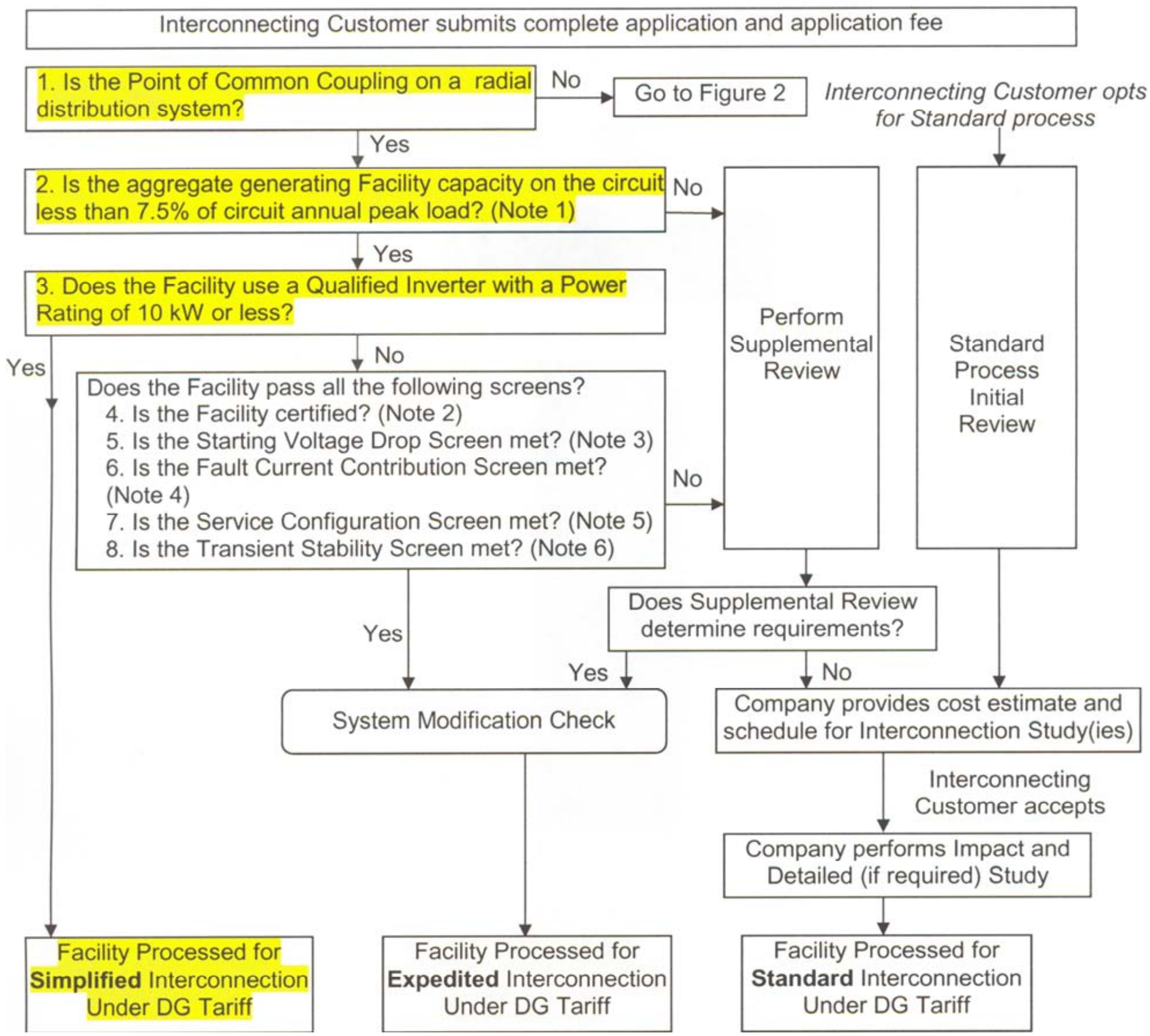

Figure 1: Illustration of the Massachusetts DG Interconnection Process Options with the SIMPLIFIED Process Highlighted

3. *Does the DG unit employ an inverter that meets national standards, and is it rated at 10 kW or less?* Both inverter manufacturers and utilities worked together in recent years to establish inverter operating requirements, of which the most common is UL 1741. All modern inverters designed for grid interconnection meet this 1999 standard, so that no DG application to date has been refused based on failure to meet the standard.

In summary for the Simplified process, any application meeting these three criteria is approved promptly for installation. The utility retains an option to examine the final system after approval by the local (municipal) electrical inspector, to ensure that the stated inverter was installed and that any specific applicable utility requirements have been met. After final utility approval, the customer is authorized to interconnect and operate the DG unit. The maximum time allowed for the Simplified process is 15 business days, although most complete applications are approved the same day they are processed by the utility.

The ***Expedited*** process was designed to allow the great majority of DG units under 1 MW to be processed for interconnection more quickly than the standard review process. In fact there is no arbitrary kW level to qualify for the Expedited process, but the majority of DG units interconnected to date were under 100 kW. Figure 2 shows the Expedited process in flow chart form with each step highlighted; these are discussed below.

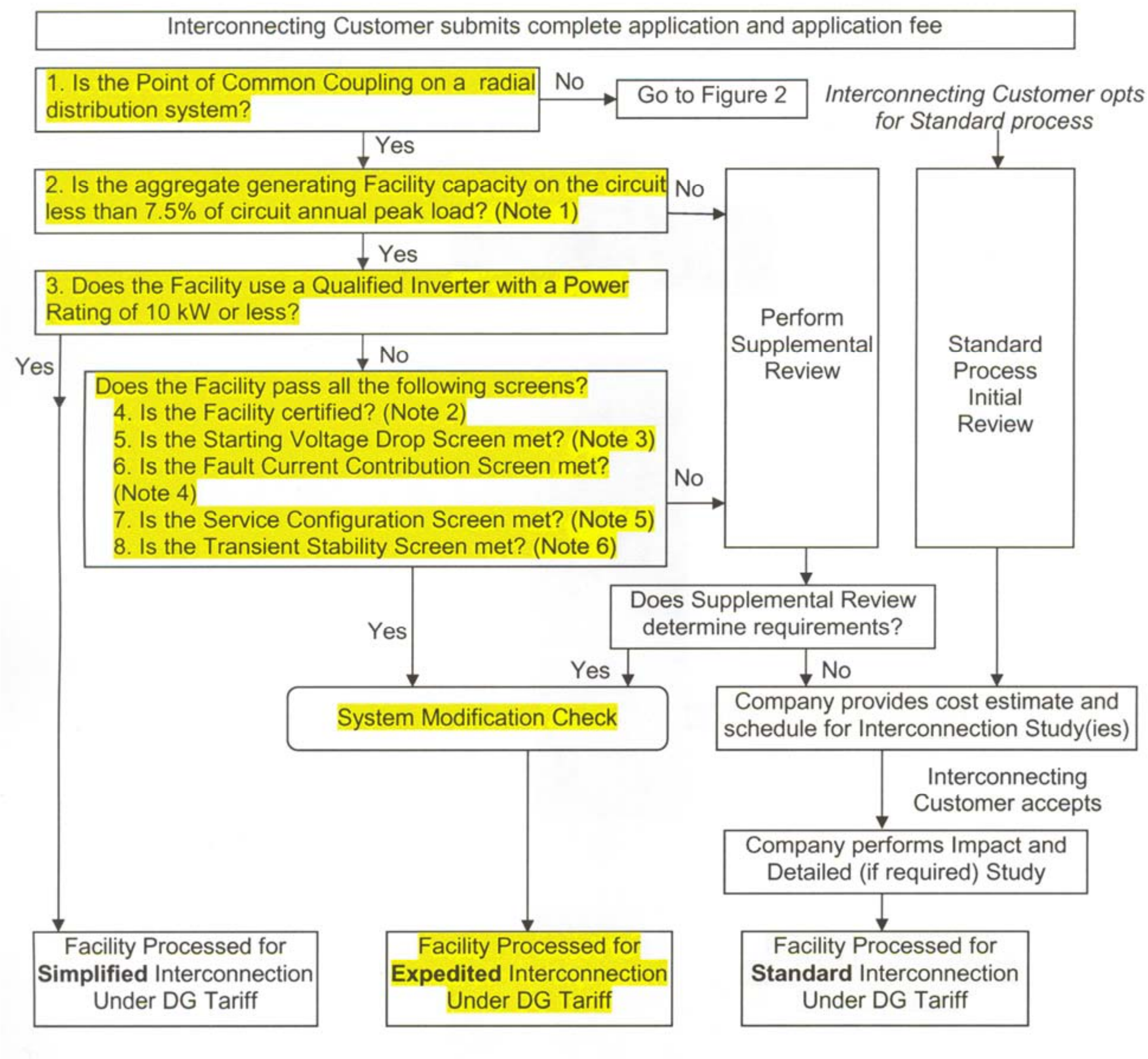

Figure 2: Illustration of the Massachusetts DG Interconnection Process Options with the EXPEDITED Process Highlighted

Questions 1. and 2. are the same as in the Simplified process, with the same purposes.

3. *Does the DG unit employ an inverter that meets national standards, and is it rated at 10 kW or less?* It is assumed the answer is No, or the customer would qualify for the Simplified process. A No answer leads to the five screening questions.

4. *Is the DG unit certified to meet utility interconnection requirements established by state regulatory agencies or independent testing laboratories who have applied national standards?* Several states (CA and New York in particular) have established qualifying criteria and a list of DG units that can be interconnected promptly on radial distribution systems under typical conditions. Another example is an inverter rated over 10 kW that meets UL Standard 1741.

5. *Starting Voltage Drop Screen*: this applies only to induction generators started as motors, and establishes a limit on the allowable voltage drop.

6. *Is the DG unit fault current contribution within prescribed limits?* Applicable primarily to induction generators, a utility analyst needs to determine if the DG short-circuit (fault) contribution would not adversely impact circuit protective devices (e.g., fuses or circuit breakers). A "Yes" answer leads to the next screen.

7. _Is the proposed type of DG circuit connection appropriate for the local (on-site) distribution system configuration?_ The most likely answer is Yes, or the customer may be able to reconfigure the DG output circuit to achieve compliance. In either case, this would lead to the final screen.

8. _Is the DG unit likely to cause local instability in voltage or frequency for the site proposed?_ A utility analysis is required to determine this, but it does not apply to inverters and is usually a relatively rare situation. No DG units have failed this screen to date.

Finally, if all the Expedited process screens are passed, there may be some minor distribution system modifications that a utility may need to carry out, such as replacing a fuse or transformer with a higher-rated component. After this step is passed, the customer can proceed with DG installation. The maximum time allowed for the Expedited process is 60 days, but the units processed to date have taken much less time.

The ***Standard*** process has been used for many years and is appropriate for large (MW-scale) DG units which typically employ engine-driven synchronous generators. This process may require an initial impact study to determine potential effects of the DG unit on the distribution system, a detailed study to determine the parameters of required additional components or modifications, and then construction according to the required system changes. Because of time spent in the exchange of documents between the DG owner, utility, consultants and contractors, the process typically takes years. Nevertheless, even this process has been simplified under the new Massachusetts DG tariff: the new maximum time allowed is 150 business days.

III THE TARIFF AND NETWORK SYSTEMS

Installation of DG on the two types of network distribution systems, **spot** and **area** (also called grid or street networks) was also considered by the collaborative partners in developing the new Massachusetts DG tariff. The two types of networks were treated separately, with more attention given to spot networks. These networks were taken up first because in some cases the owner of a large urban building served by a spot network who wished to install DG would be the one to experience any potential problems caused by the DG unit adversely affecting the network protectors. In contrast, DG on an area network has the potential to cause outages for the hundreds of customers served by a typical area network.

Network protectors are highly-specialized circuit breakers with control systems that monitor power flowing into and out of the building from the network transformers. A network protector opens its circuit breaker instantly if it detects power flowing back toward the supply circuits, which would be the case if a fault developed on the supply circuit to the spot network. This reverse power flow could also happen if the DG unit were to momentarily generate more power than the building electrical load, which is the primary reason utilities have been reluctant to allow DG on networks. Reverse power flow for any reason would cause the network protectors to operate, with the potential for damage to the protectors and all the consequences of an outage to people and equipment in the building.

As a step toward opening the door to DG on networks, the collaborative established a new process to allow certain types of DG on spot networks. This process is shown in Figure 3. The first and second criteria are identical to the third criterion of the Simplified process, but the fourth is new. Requiring that the maximum DG capacity be less than 1/15 of the minimum load recorded at the facility is a reasonable means of ensuring that the DG unit is very unlikely to produce reverse power flow that would open the network protector(s). The fourth box allows system changes to be made if necessary, but this is not regarded as likely for most applications. There have been no applications for DG on spot networks to date.

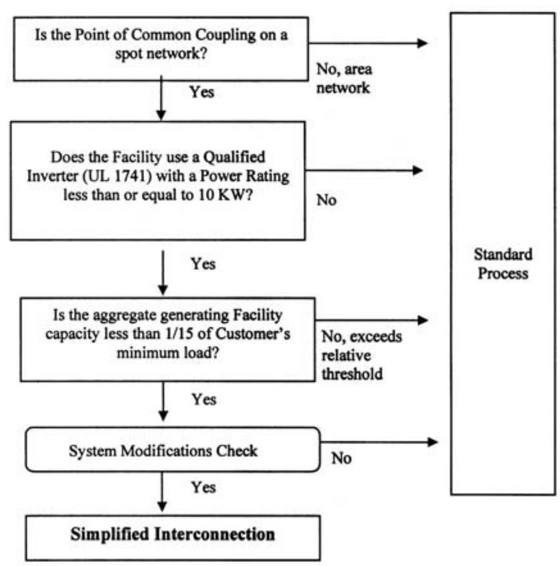

Figure 3: Illustration of the Massachusetts Interconnection Process for a Small DG Unit on a Spot Network

IV. CONCLUSIONS

The tariff has been in effect for one year and seven months, with over 60 DG applications completed or in process at National Grid. Several forms have been modified slightly to clearly identify all parties involved in the more complex installations (e.g., owner, consultant, PV contractor, electrical contractor), but the Simplified process has accomplished its primary goal of making the DG interconnection process as fast and easy as possible for PV and wind energy systems. Eight DG applications have been processed using the Expedited procedure; complete applications were processed quickly, but some customers needed guidance on required electrical drawings and technical material.

Since the tariff was approved, several other states have issued new DG interconnection policies and procedures. Some aspects of these go beyond the limits and areas specified in the Massachusetts tariff. For example, the New York Public Service Commission has stated that investor-owned utilities in the state must allow certain types of generators to be connected to area networks, but has not indicated how it should be done. Further, the NY Standardized Interconnection Requirements (SIR) for DG rated less than 2 MW or less does not specifically indicate what is required for spot or area network interconnections. The SIR document does acknowledge that the utility will need to analyze a given DG application for network interconnection in detail, then specify what would be required in terms of protective equipment and possibly system modifications.

The New Jersey Board of Public Utilities (BPU) has adopted a similar broad policy of allowing DG on networks, but specific regulations or tariffs have not been developed or posted to the BPU web site.

In conclusion, the current Massachusetts tariff has made the DG interconnection process easier and faster, but the collaborative process will continue in the near future to examine opportunities for improvement of the tariff.

BIOGRAPHY

John J. Bzura was born in Albany, Georgia, U.S.A., on September 14, 1944. He received the B.S., M.E.E. and Ph.D. degrees from Cornell University, Ithaca, NY, in 1966, 1967 and 1971, all in electrical engineering. In 1974, an M.B.A. degree was granted by Syracuse University, Syracuse, NY.

He was employed by Arthur D. Little, Inc. from 1974 to 1983, where he performed technical and economic analyses of energy systems. He joined the New England Power Service Company (now National Grid USA Service Company) in 1983, and spent 10 years as Principal Engineer in the Demand Planning R&D Group. The last 11 years have been with the R&D / Technology Transfer group within the Engineering department in Northborough, MA. Projects and topics of interest include solar and wind energy systems, distributed generation (DG) technologies, DG interconnection issues, distributed energy storage, electric vehicles and broadband over power-line (BPL) communications.

He is a Senior Member of the IEEE Power Engineering Society, the Energy Development Subcommittee (EDS) and serves as Chairman of the Distributed Generation and Energy Storage Working Group within the EDS.

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