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Renewable Generator Interconnection

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Agenda

- Overview of generator interconnection process
- State vs. Federal jurisdiction
  - State interconnection process at a Maine electric utility
  - Federal Energy Regulatory Commission (FERC) interconnection process at ISO-NE

Why have a standardized interconnection process?

- Expedites new generator interconnections
- Helps to ensure grid reliability
- Avoids discrimination

What is the Interconnection Process?

- Process of getting an interconnection agreement with the local transmission and distribution company and/or ISO-NE
- The process is used to make sure interconnecting generators are integrated into the distribution and/or transmission system responsibly with respect to impacts on reliability, power quality and safety
  - For example, can not allow distributed generator to affect neighbors on feeder
- All costs of interconnection are generally the responsibility of interconnecting generator

Importance of the Interconnection Process

- Following the interconnection process is important because, for instance
  - a distributed generation system changes the one-way power flow from the utility to customer, which can present dangers to utility workers if proper equipment is not installed
  - a large generator changes power flows on the transmission system and may cause transmission circuit overloading under certain operating scenarios, affecting transmission system reliability. This is especially important for new variable renewable generation integration like wind.

- While robust and capable of handling minor disturbances, the quality of grid power is extremely important. The interconnection process ensures generation meets safety, reliability, & power quality requirements with regard to:
  - Islanding
  - Transient Voltage Conditions
  - Noise and Harmonics
  - Frequency
  - Voltage Level
  - Machine Reactive Capability

Generator Interconnection State vs. Federal Jurisdiction

- ***Federal (FERC Orders 2003, 2006, 661, others)***
  - All transmission interconnections
  - Distribution interconnections that already have a generator in the wholesale energy market, and the interconnecting generator will be in the wholesale energy market
- ***State***
  - Behind-the-meter generation (offsetting customer load)
  - Qualifying Facility (QF) generation (e.g., cogeneration)
  - Maine PUC standard interconnection procedures:
    - 2009 report to Legislature - "Statewide interconnection procedures for Maine's utilities should be imposed."
    - Effective in 2013, Chapter 324 Rule
      - http://www.maine.gov/tools/whatsnew/attach.php?id=93709&an=2

Governing Regulations and Bodies

- State jurisdiction vs. FERC jurisdiction
  - Will your system impact the bulk power system (transmission)?
  - Will you sell to the market or will you sell to the host utility as a QF or under net metering?
  - Are you the "first on" the distribution feeder?
- ISO-NE Schedule 22 and Schedule 23: If you will be connecting to the transmission system, or if you will sell to the market on an existing "FERC jurisdictional" feeder.
  - Independent System Operator New England administers
  - Significant application fee and queue-ing
- Distribution Level interconnection tariffs: Connection to a distribution feeder under "State Jurisdiction"
  - Local Distribution Company administers
  - Investor owned utilities in Maine now have a standardized process (Chapter 324)

State jurisdictional interconnection

- Small, distributed generation that connects to the distribution system primarily requires a State jurisdictional, local utility administered interconnection process.
  - <5 MW only necessitates ISO-NE notification of interconnection
- The Maine PUC specifies the local distribution system interconnection standards in Chapter 324 Rule. This process is used by the two investor owned utilities (IOU) in Maine (Central Maine Power (CMP) and Emera Maine)
- Municipally-owned utilities are not required to follow this process, and may follow a different criteria.

Maine Chapter 324 Small Generator Interconnection Rule

- **4 Levels of interconnection review based upon size**
  - **Level 1** - For certified, inverter-based facilities with a power rating of ten kilowatts (10kW) or less on radial or Spot Network systems under certain conditions.
  - **Level 2** - For certified generating facilities that pass certain specified screens and have a power rating of two megawatts (2MW) or less.
  - **Level 3** - For certified generating facilities that: (a) pass certain specified screens; (b) do not export power beyond the Point of Common Coupling; and (c) have a power rating of ten megawatts (10MW) or less.
  - **Level 4** - For all generating facilities that do not qualify for Level 1, Level 2 or Level 3 interconnection review processes, and are not subject to the jurisdiction of FERC.

Federal (ISO-NE) Jurisdiction of Interconnection

- If project is large enough (>6 -10 MWs), will need to interconnect to transmission system through Federal Energy Regulatory Commission (FERC) Small Generator Interconnection Procedures (SGIP)
  - Need to apply to the New England Independent System Operator (ISO-NE)
- If you will be selling your power to a third party, or bidding in capacity to the Forward Capacity Market (FCM) you may have to apply through ISO-NE
- If circuit is already “FERC Jurisdictional” and project is selling to a third party, it will need to apply to ISO-NE.
  - If another generator is selling to the wholesale market, then the circuit is FERC jurisdictional

http://www.iso-ne.com/genrtion_resrcs/nwgen_inter/index.html

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Generator Interconnection Process

Large Generator (> 20 MW) or Small Generator (<= 20 MW)

- Large Generator Interconnection Process in ISO Tariff Schedule 22
  www.iso-ne.com/regulatory/tariff/sect_2/sch22/09-2-1%20fcmq-sched_22_.pdf
- Small Generator Interconnection Process in ISO Tariff Schedule 23
  www.iso-ne.com/regulatory/tariff/sect_2/sch23/09-2-1_fcmq_sched_23.pdf
- Generator Interconnection Technical & Market Requirements
  www.iso-ne.com/genrtion_resrcs/nwgen_inter/req/index.html
- Application for Interconnection
  - Large (> 20 MW, with $50,000 deposit)
    www.iso-ne.com/genrtion_resrcs/nwgen_inter/lg_gen/index.html
  - Small (<= 20 MW, with $1,000 deposit)
    www.iso-ne.com/genrtion_resrcs/nwgen_inter/smgen_20/index.html
  - Less than 5 MW (notification only)
    www.iso-ne.com/genrtion_resrcs/nwgen_inter/req/gen_not_form_less_5mw.doc
- Generator Interconnection Queue
  www.iso-ne.com/genrtion_resrcs/nwgen_inter/status/index.html

ISO-NE Interconnection Queue (snapshot)

- (updated monthly)

ISO New England Study Request Database - Public

Active Projects as of 2/28/2014

FERC Administered Transmission System

QP	Updated	Type	Requested	Alternative Name	Unit	Fuel Type	Net MW	SumMW	WinMW	County	ST	OpDate	SyncDate	Interconnection Point	Serv	SIS	I39	TO Report	Dev	Zone
89	11/22/2013	G	6/6/2001	Cape Wind Turbine Generators	WT	WND	462	462	462	N/A	MA	5/31/2016	1/31/2016	Near Barnstable 115 kV Substation	CNR	Yes	Yes	ISO-NE		SEMA
178	9/25/2013	G	11/2/2006	Brockton Combined Cycle	CC	NG DFO	332	332	371	Plymouth	MA	4/19/2017	12/14/2016	115 kV F19 and E20 lines	NR	Yes	Yes	ISO-NE		SEMA
196	5/30/2013	G	1/16/2007	Northfield Mt. Upgrade #4	PS	WAT	25	295	295	Franklin	MA	6/1/2014	6/1/2014	W. Mass Northfield 345 kV substation	CNR	Yes	Yes	ISO-NE		WMA
196	5/30/2013	G	1/16/2007	Northfield Mt Upgrade #1	PS	WAT	25	295	295	Franklin	MA	6/1/2016	6/1/2016	W. Mass Northfield 345 kV substation	CNR	Yes	Yes	ISO-NE		WMA
251	1/27/2014	G	2/15/2008	Burgess BioPower	ST	WDS	58.7	58.7	58.7	Coos	NH	3/7/2014	10/25/2013	PSNH Eastside(Berlin) Substation	CNR	Yes	Yes	ISO-NE	PD	NH
272	9/23/2013	G	8/1/2008	Oakfield II Wind - Keene Road	WT	WND	147.6	147.6	147.6	Aroostoock	ME	12/31/2015	11/30/2015	BHE Keene Road Substation	NR	Yes	Yes	ISO-NE	PD	BHE

Generator Interconnection Process
Energy Market

- **Energy Market Only – Follow "traditional" interconnection process (ISO PP5-6 Minimum Interconnection Standard)**
  - Application for Service
  - Scoping Meeting
  - Optional Feasibility Study
  - System Impact Study
  - Optional Facilities Study
  - Interconnection Agreement

Generator Interconnection Process
Capacity Market

- **Capacity Market – Participate in Forward Capacity Market plus "traditional" interconnection process (ISO PP-10)**
  - Optional Non-Binding Group Analysis ("overlapping impact")
  - Optional Commitment to Upgrades to allow Capacity market participation
  - Participate in Forward Capacity Auction corresponding to in-service date
  - "Overlapping impact" study (if not already done), if capacity bid accepted from auction,
  - Commit to required upgrades for Capacity Market participation

The System Impact Study
Reliability with Generator Interconnection

- Accurate models are fundamental
- Transmission system must accommodate uncertainty and variability – assess reasonably stressed system conditions as appropriate (per ISO Planning Procedure 5)
- Generation must perform acceptably for a variety of disturbances (per NPCC Basic Criteria and ISO Reliability Standards - Planning Procedure 3)
- Acceptable performance requires:
  - "Low voltage ride-through" during system disturbances
  - Sufficient power factor for voltage control before and after disturbances
- Assess steady state, short-circuit, and dynamic stability performance

System Planning Implications

- ***Engineering models must accurately reflect the characteristics of renewable generators***
  - Voltage and frequency ride-through capability required
  - Real and reactive power response for voltage control
  - Manufacturers have unique designs with different control & performance features – all are induction generators
    IEEE standard model effort is underway
  - Low/no inertia for wind generators – possible larger frequency excursions
- ***Wind Resources are in remote locations from most of the load centers and backbone transmission system***
  - "weak system" issues
  - Additional reinforcement may be needed
- ***"Wind Farms" are composed of tens to hundreds of individual generators***
  - A "farm" has its own collector network, typically to a "hub"
  - Hundreds of generators (typically 1.5 to 3 MW each) with their own control systems
  - Master control with slower response time
- ***Assessment of expected capacity value for Area resource adequacy***

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Questions?

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