Centralized Forecasting – Registration and Communication Requirements for Distribution Connected Variable Generators

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Centralized Forecasting - Registration and Communication Requirements for Distribution Connected Variable Generators

AN IESO MARKETPLACE TRAINING PUBLICATION

This guide has been prepared to assist in IESO training and has been compiled from extracts from the market rules or documents posted on the web site of Ontario's Independent Electricity System Operator. Users of this guide are reminded that they remain responsible for complying with all of their obligations under the market rules and associated policies, standards and procedures relating to the subject matter of this guide, even if such obligations are not specifically referred to herein. While every effort has been made to ensure the provisions of this guide are accurate and up to date, users must be aware that the specific provisions of the market rules or particular document shall govern.

The Independent Electricity System Operator
Box 4474, Station A
Toronto, Ontario
M5W 4E5

Customer Relations Tel: (905) 403-
6900 Toll Free Tel: 1-888-448-7777

www.ieso.ca

Table of Contents

1. Introduction

Welcome to Ontario's IESO!

This guide explains what you need to do to register your wind or solar facilities with the IESO centralized forecasting service and communicate with the IESO. This is supplemental to information found in *Market Manual 1.0: Market Entry, Maintenance, and Exit*, and *Market Manual 1.2: Facility Registration, Maintenance, and De-registration.*

If you have any questions as you follow this guide, please call Customer Relations at 1-888-448-7777, or if assigned, contact your Market Registration – Project Manager.

2. Participant Registration

Small and large generators can make a significant aggregate contribution to security of supply for Ontario consumers. As such it is important for all wind and solar generation facilities that are 5MW or larger to register with the IESO for the centralized forecasting service.

WHO NEEDS TO REGISTER?

Market Manual 1.0: Market Entry, Maintenance, and Exit and *Market Manual 1.2: Facility Registration, Maintenance, and De-registration* state that "All variable generators must register with the IESO to provide operational and meteorological monitoring data for centralized forecasting."

The Market Rules under Chapter 11 considers variable generation to mean all wind and solar photovoltaic resources with an installed capacity of 5 MW or greater, or all wind and solar photovoltaic resources that are directly connected to the IESO-controlled grid (ICG).

TYPES OF PARTICIPANTS

There are two kinds of participants with variable generation. They are:

Market Participants are authorized by the Market Rules to directly participate in the IESO-administered markets. To become a Market Participant, please see the Registration webpage on the IESO website.

Program Participants are connected through the distribution system via a local distribution company (LDC) and are not required to be Market Participants.
Distribution connected variable generators are required to provide operational and meteorological monitoring data outlined in *Market Manual 1.0: Market Entry, Maintenance, and Exit*, and *Market Manual 1.2: Facility Registration, Maintenance, and De-registration*.

3. Data Requirements

This section outlines the data requirements of the IESO, distinguishing between facility data, operational data, and meteorological data from both wind and solar facilities.

There are two types of data that the IESO requires from variable generators:

1. **Facility Data** - must be reported at time of registration
    - Facility Data (Includes facility location, generating unit location and characteristics, etc.)
2. **Monitoring Data** - must be reported every 30 seconds
    - Operational Monitoring (Includes megawatt output and available megawatts)
    - Meteorological Monitoring (Includes wind speed, barometric pressure, temperature, etc.)

More detailed information on the centralized forecasting data requirements can be found in *Market Manual 1.0: Market Entry, Maintenance, and Exit* and *Market Manual 1.2: Facility Registration, Maintenance, and De-registration.*

The IESO will provide a telemetry spreadsheet to assist variable generators in providing the required facility monitoring data. Where Monitoring data is to be provided by participant via VPN[1], the telemetry spreadsheet needs to be completed with maximum and minimum engineering values sections and the RTU representation details. The telemetry spreadsheet must be returned to the IESO when it is has been completed.

[1] Please see *Participant Technical Reference Manual,* available on the Market Rules and Manuals Library webpage for more information.

FACILITY DATA – WIND

All facility data information for wind generators must be supplied to Market Registration via Online IESO.

The following facility data is required from wind facilities:

Turbine Hub Location	The longitude and latitude of the hub. Also include the height and elevation from sea level
Meteorological (MET) Tower or SODAR Unit Location	The longitude and latitude of the tower along with its height and elevation from sea level Met towers require measurement at hub height, SODAR units should measure at hub height as well as 50 m and 110 m, if possible
Type of Turbine	Whether the turbine is a horizontal or vertical axis type
Manufacturer's Power Curve	Power curve containing expected output for a turbine at varying wind speeds
Cut-in Speed	The lowest wind speed (meters per second) at which a turbine will generate power
Cut-out Speed	The wind speed (meters per second) at which a turbine must shut down to prevent damage
Cut-out Temperature	The maximum and minimum ambient temperature (in Celsius) at which the turbine will be shut down to prevent physical damage

FACILITY DATA – SOLAR

All facility data information for solar generators must be supplied to Market Registration via Online IESO.

The following information must be filled out:

Solar Facility Location (longitude and latitude)	Physical location (GPS coordinates of) of each solar array. Solar array is defined as a collection of solar panels that share a connection point. The physical location should be representative of the GPS coordinates at the centre of each solar array such that every solar panel within that array is within 5km of the GPS coordinates. In the event that the array is larger, additional GPS coordinates will be required to outline the geographic footprint of the array.
Meteorological Data Collection Device Location and Elevation (latitude and longitude)	Physical location (GPS coordinates) of each MET data collection device and its height and elevation from sea level
Elevation and Orientation Angles of Arrays	Height from ground level and angle of each solar array, Tilt (angle with horizontal plane) and Azimuth (angle in North-East-South West Plane). Fixed angle panels only. If the array is sub-divided and tilted at different angles, please provide the coordinates of the subdivisions and separate angles.
Power Rating (per panel)	Rated power at standard test conditions
Generation Capacity of the Generating Facility and Each Generating Unit	The name plate capacity of the entire facility with a breakdown for each array with the system (DC and AC Power at standard test conditions for arrays and powers of inverters)
Temperature Coefficient	The temperature coefficient of the module power at the maximum power point
Type of Mounting	The type of mounting used (eg. Ground, rooftop, single or dual axis tracking)

Module Type	The type of technology used (crystalline, thin-film)
Wind Protection	Wind speed at which panels are stored to avoid damage. (If applicable)

OPERATIONAL DATA – WIND & SOLAR

Available Megawatts

This value is the sum total of capacity per connection point. It reflects the total available capacity of your facility and must be reported to the IESO every 30 seconds (explained further in the Communication section of this guide).

The sum total of the capacities of all available turbines or solar panels per connection point should not take into account ambient conditions such as wind speed, solar irradiance.

If a turbine or panel is unavailable to generate, i.e., under repair or disconnected due to upstream equipment outages, the Available Megawatt value shall be adjusted to not include that turbine or panel until it returns to service. (i.e., available MW = maximum capacity – not in service).

Measurement type	*Definition*	*Unit of Measure*	*Data Required For*	*Measurement Precision*
MW Output (per facility)	Current MW output for the facility	Megawatt (MW)	All	0.1 MW
Available Megawatts	What the facility can produce after deducting unavailable turbine or panels MW	Megawatt (MW)	All	0.1 MW

Meteorological Data – Wind

As part of *Market Manual 1.0: Market Entry, Maintenance and Exit Overview*, and *Market Manual 1.2: Facility Registration, Maintenance, and De-registration*, available on the Market Rules and Manuals webpage, it is a requirement for wind generators to have meteorological data collection points. The following are the conditions that collection points must adhere to:

- Meteorological data collection points can be any of the following:
  - Meteorological Towers (MET tower).
  - Nacelle-mounted data collection equipment.
  - A combination of both.
- No turbine shall be further than 5 km from the nearest meteorological data collection point. This is the minimum requirement only and facilities may collect and send this data from as many points at the *facility* as are available. Data collection can be accomplished by using meteorological towers, SODAR technology, nacelle mounted equipment, or a combination of these methods. Multiple facilities can provide data from the same data collection points if they are within the 5 km range. The following are the requirements for the total number of Meteorological Towers or SODAR units based on the facility size:

Facility Size	*Required MET Towers or SODAR units*
Less than 10 MW	None
10 MW to less than 100 MW	Minimum of 1
100 MW to less than 200 MW	Minimum of 2
200 MW to less than 300 MW	Minimum of 3
300 MW to less than 400 MW	Minimum of 4

Note: The meteorological data collection point can only submit meteorological conditions experienced by one particular turbine at a given point in time. It should not aggregate and average meteorological data from multiple turbines

Please see Appendix A for illustrated examples of different configurations.

The following table identifies the Meteorological Monitoring Requirements for the MET Towers or SODAR Units.

Measurement Type	*Unit of Measure*	*Height of Measurement*	*Precision (to the nearest)*
Wind Speed	Meters per second (m/s)	Met towers require measurement at hub height, SODAR units should measure at hub height as well as 50 and 110 m if possible	0.1 m/s
Wind Direction	Degrees from True North	Met towers require measurement at hub height, SODAR units should measure at hub height as well as 50 and 110 m if possible	1°
Ambient Air Temperature	Degrees Celsius (°C)	Any Height	0.1°C
Barometric Pressure	Hectopascals (HPa)	Any Height	0.1 HPa
Relative Humidity	Percentages (%)	Any Height	1.0%

The following table identifies Meteorological Monitoring Requirements from Nacelle mounted data collection points.

Measurement Type	Unit of Measure	Height of Measurement	Precision (to the nearest…)
Wind Speed	Metres per Second (m/s)	Hub height	0.1 m/s
Wind Direction	Degrees from True North	Hub height[18]	1 degree
Ambient Air Temperature	Degrees Celsius (°C)	Can be provided from any height	0.1 °C
Barometric Pressure	Hectopascals (HPa)	Can be provided from any height	0.1 HPa
Relative Humidity	Percentage (%)	Can be provided from any height	1.0%

Note: that the wind direction measured at the nacelle may only be used if properly calibrated and if it continues to be provided when the turbine is not generating. Wind direction values may be provided from lower heights if only hub direction can be provided from hub height.
Wind data collected at the nacelle is expected to represent the apparent wind not the true wind value at a facility.

It is understood that there will be some error associated with measurements taken on the nacelle due to the spinning blades.

- For example, the wind speed precision requirement of 0.1 m/s requires that the measurement gives values with one decimal place; the accuracy of the data is detailed in **Section 4.1.3 of Market Manual 6.**

Meteorological Data - Solar

Each solar facility is required to have meteorological data points. *Market Manual 1.0: Market Entry, Maintenance and Exit Overview***,** and *Market Manual 1.2: Facility Registration, Maintenance, and De-registration*, available on the Market Rules and Manuals webpage, outline the requirements for each facility. The specific solar facility requirements are:

- No solar panel shall be further than 12km from the nearest two meteorological data collection points.

Multiple facilities can provide data from the same data collection points if they are within the 12 km range. Please see Appendix B for illustrated examples of different configurations.

The following are the Meteorological Monitoring Requirements for Solar facilities:

Measurement Data	*Definition*	*Unit of Measure*	*Data Required For*	*Precision (to the nearest)*
Plane of Array (POA)	Measurements perpendicular to the solar receiver	Watts/Square Metre (Watts/m^2)	Crystalline,Thin-Film,CPV	+/- 1 Watts/m^2
Global Horizontal Irradiance (GHI)	The solar irradiance available to a flat-plate collector oriented horizontal to the earth's surface	Watts/Square Metre (Watts/m^2)	Crystalline,Thin-Film,CPV	+/- 1 Watts/m^2
Direct Irradiance (DNI)	The amount of solar radiation received per unit area by a surface that is always held perpendicular (or normal) to the rays that come in a straight line from the direction of the sun at its current position in the sky.	Watts/Square Metre (Watts/m^2)	CPV	+/- 1Watts/m^2
Ambient Temperature at the Array Average Height	Ambient temperature at the array average height	Degrees Celsius (°C)	Crystalline,Thin-Film,CPV	0.1°C
Back of Module Temperature	Average temperature at the back of module The GPS	Degrees Celsius (°C)	Crystalline,Thin-Film,CPV	0.1°C

	coordinates of the back of module temperature measurement locations must also be included.			
Barometric Pressure	Barometric Pressure	Hectopascals (HPA)	Crystalline,Thin-Film,CPV	0.1 HPa
Wind Speed at the Array Average Height	Anemometer, wind vane or wind mast readings	Metres/Second (m/s)	Crystalline,Thin-Film,CPV	0.1 m/s
Wind direction at the Array Average Height	Wind vane or wind mast readings	Degrees from True North	Crystalline, Thin-Film, CPV	1 ° C

4. Communication

This section outlines how variable generators can communicate their operational and meteorological monitoring data to the IESO.

TELEMETRY

Operational data must be reported to the IESO at least once every 30 seconds on a "per facility" basis.

Please note that there are no registration forms to submit for the dynamic data (operational and meteorological monitoring data). the IESO will provide a telemetry document that shall be used by the facility owner to identify dynamic data points listed in the Operational and Meteorological Monitoring tables for wind and solar facilities.

COMMUNICATION PATHWAYS AVAILABLE TO DISTRIBUTION CONNECTED WIND AND SOLAR FACILITIES

All wind and solar facilities 5 MW and greater will be subject to Centralized Forecasting. They will be required to communicate with the IESO.

The IESO offers two communication pathways to distribution connected wind and solar facilities:

1. via a Local Distribution Company (currently only available with Hydro One)
2. via a Virtual Private Network (VPN) connection over DNP3

Communication via Local Distribution Company

The IESO's preferred communication method is through the local distribution company with which your wind or solar facility is connected.

NOTE: At this time, Hydro One is the only local distribution company that has made a service available to send telemetry to the IESO. If you choose this communication method through Hydro One, this satisfies the communications requirements with the IESO, and no additional connections are required. Please contact your Hydro One representative for more information about availability.

Communication via Virtual Private Network

The IESO offers a Virtual Private Network (VPN) solution for program participants who are required to provide operational and meteorological telemetry to the IESO through a program participant DNP3 RTU. This solution will allow the IESO to receive the required telemetry data in a secure and cost effective manner. A list of IESO certified RTUs can be found within Chapter 4: Operational Metering Equipment & AGC of the Participant Technical Reference Manual.

In order to establish the VPN connection, program participants are required to provide the Internet access for the IESO equipment by one of two methods:

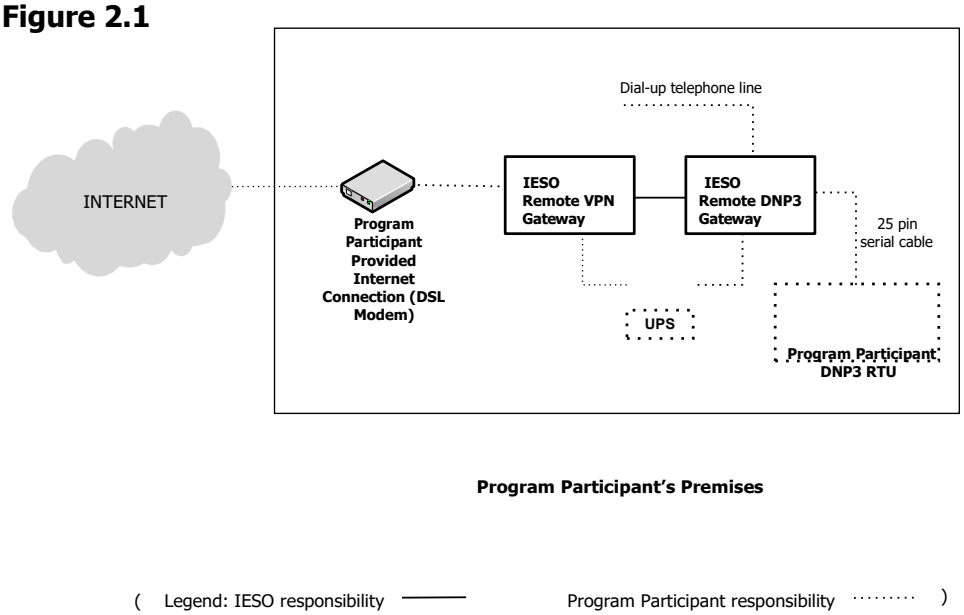
1) A dedicated DSL modem (Figure 2.1).
2) Utilizing the program participant's existing Internet facility (Figure 2.2).

For both options, the IESO will deploy a remote VPN gateway and a DNP3 gateway to the participant's site.

A site-2-site VPN will be established between the IESO remote VPN gateway at the participant's premises and the master VPN gateway at the IESO office.

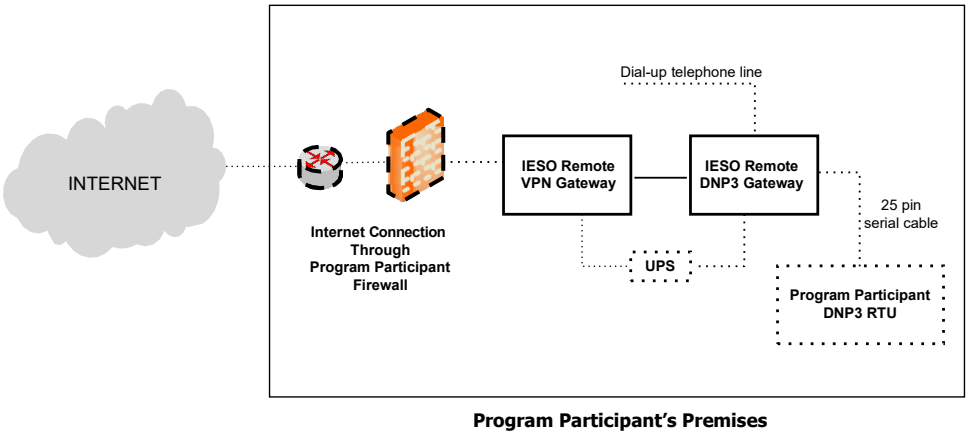
The IESO remote DNP3 gateway will collect the telemetry data from participant's RTU and transfer it back to the IESO over the VPN tunnel.

Figure 2.1



VPN Connection for DNP3 RTU via dedicated DLS modem

Figure 2.2



VPN Connection for DNP3 RTU via Program Participant Firewall

5. Exemptions

If a facility is unable to meet one or more of the requirements, applying for an exemption is an option.

An exemption application may be submitted for assessment by the Panel. The panel consists of independent directors of the IESO Board. The application must include the following:

- A detailed plan outlining timing, associated costs to make the facility or equipment compliant

Refer to *"Part 4 – Submissions in Support of Exemption Application"* of the exemptions application form for complete details.

The Panel considers the following, but not limited to, when making their decision:

a) The merits of the exemption application;

b) The public interest;

c) The type and degree of harm the exemption applicant may suffer if an exemption is not granted; and

d) The IESO's recommendation.

Complete details on the exemptions process and procedure can be found on the Change Management – Exemptions webpage on the IESO website.

If further clarification is required, please email questions to:

Exemptions@IESO.ca

6. Additional Information

If you have any questions, please call Customer Relations at (905) 403-6900 (Toll Free 1-888-448-7777), email market.registration@ieso.ca or email customer.relations@ieso.ca. Additional information is available on our website at www.ieso.ca:

IESO Registration webpages

On the Market Rules and Manuals Library webpage:

- *Market Manual 1.0: Market Entry, Maintenance, and Exit*
- *Market Manual 1.2: Facility Registration, Maintenance, and De-registration*

Appendix A: Wind Meteorological Data Requirement Examples

Figure A.1: Sample wind facility configuration #1 (less than 100 MW)
(Note: MET Tower location may also be used for SODAR Units)

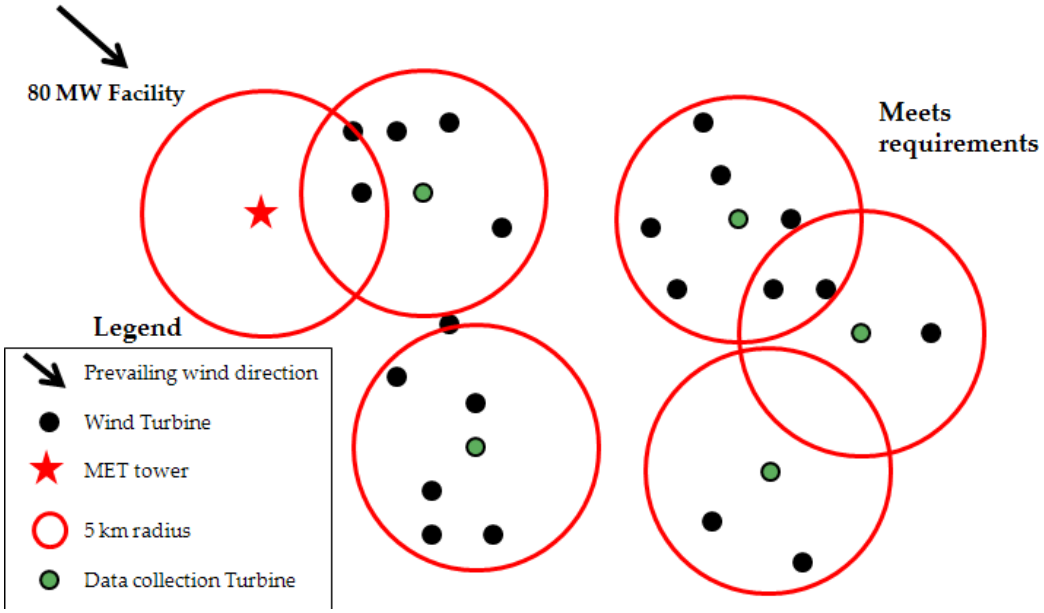


Figure A.2: Sample wind facility configuration #2 (less than 100 MW)
(Note: MET Tower location may also be used for SODAR Units)

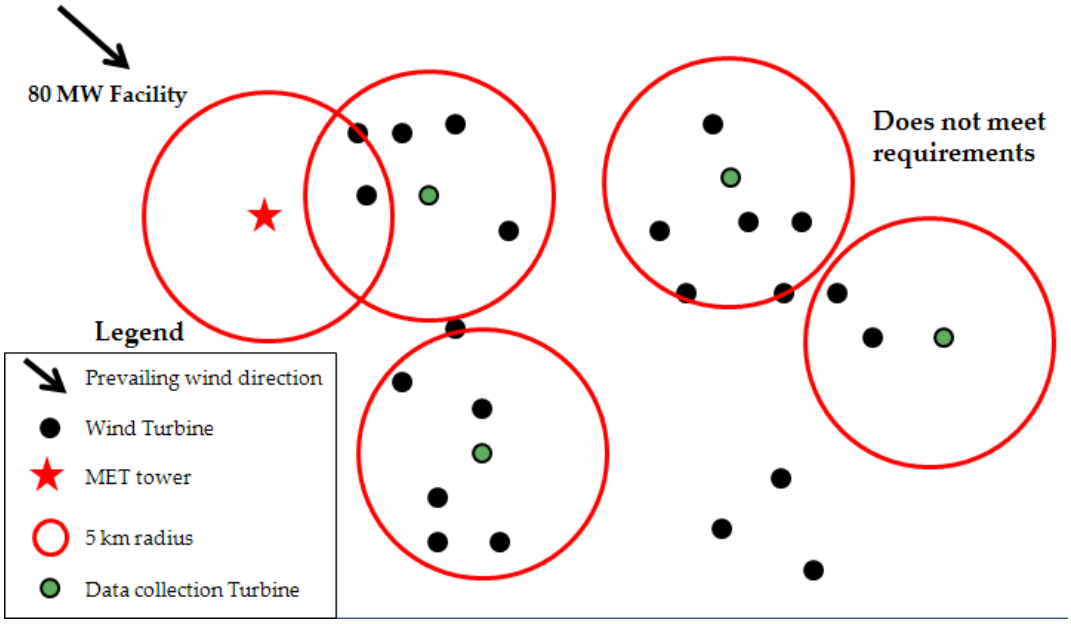


Figure A.3: Sample wind facility configuration #1 (greater than 100 MW)
(Note: MET Tower location may also be used for SODAR Units)

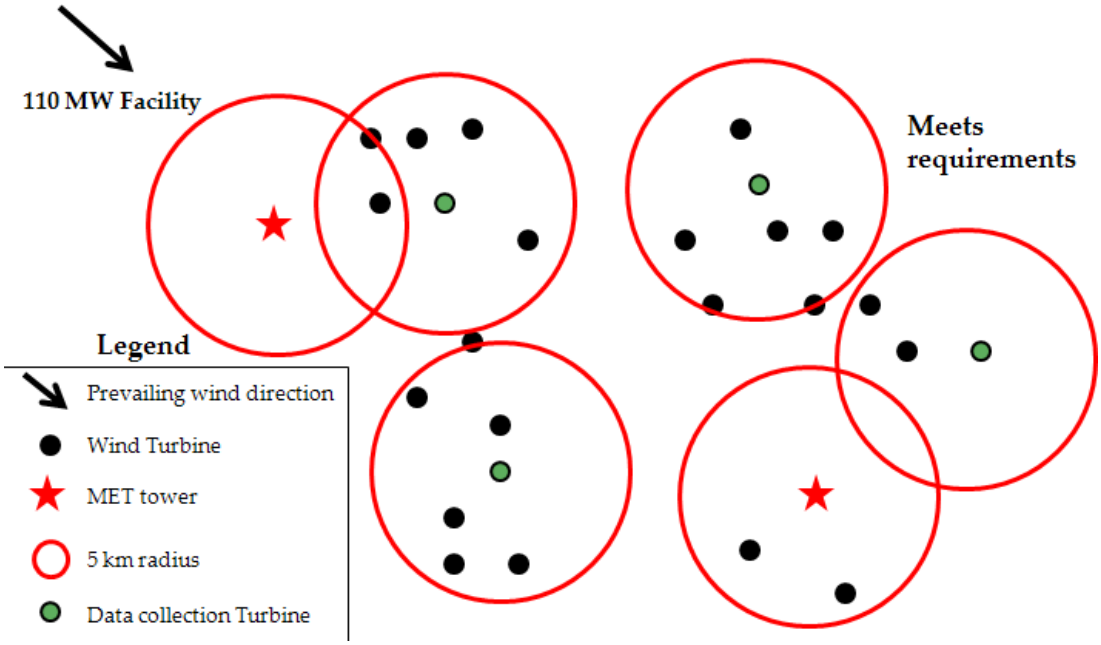
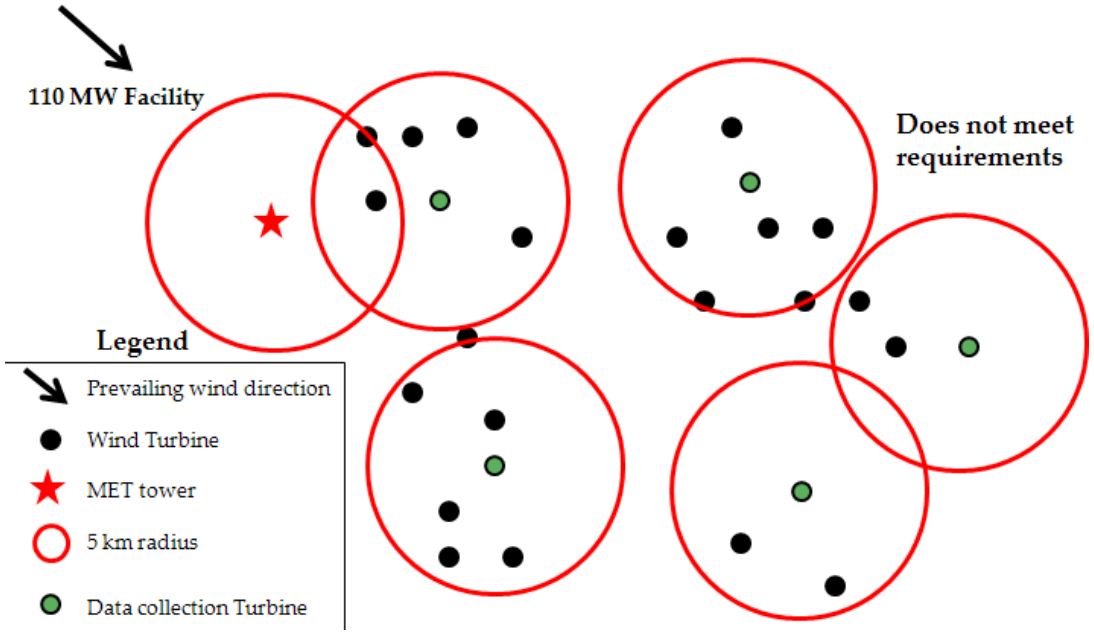


Figure A.4: Sample wind facility configuration #2 (greater than 100 MW)
(Note: MET Tower location may also be used for SODAR Units)


110 MW Facility
Does not meet requirements
Legend
Prevailing wind direction
Wind Turbine
MET tower
5 km radius
Data collection Turbine

Appendix B: Solar Meteorological Data Requirement Examples

Figure B.1: Sample solar facility configuration #1

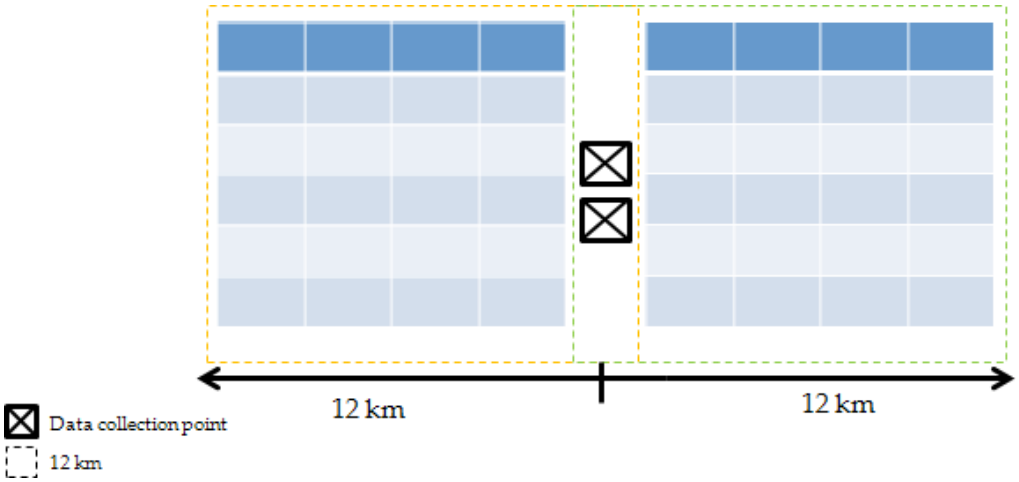


Figure B.2: Sample solar facility configuration #2