TRADEWINDS® POWER CORP

Information Sheet #6

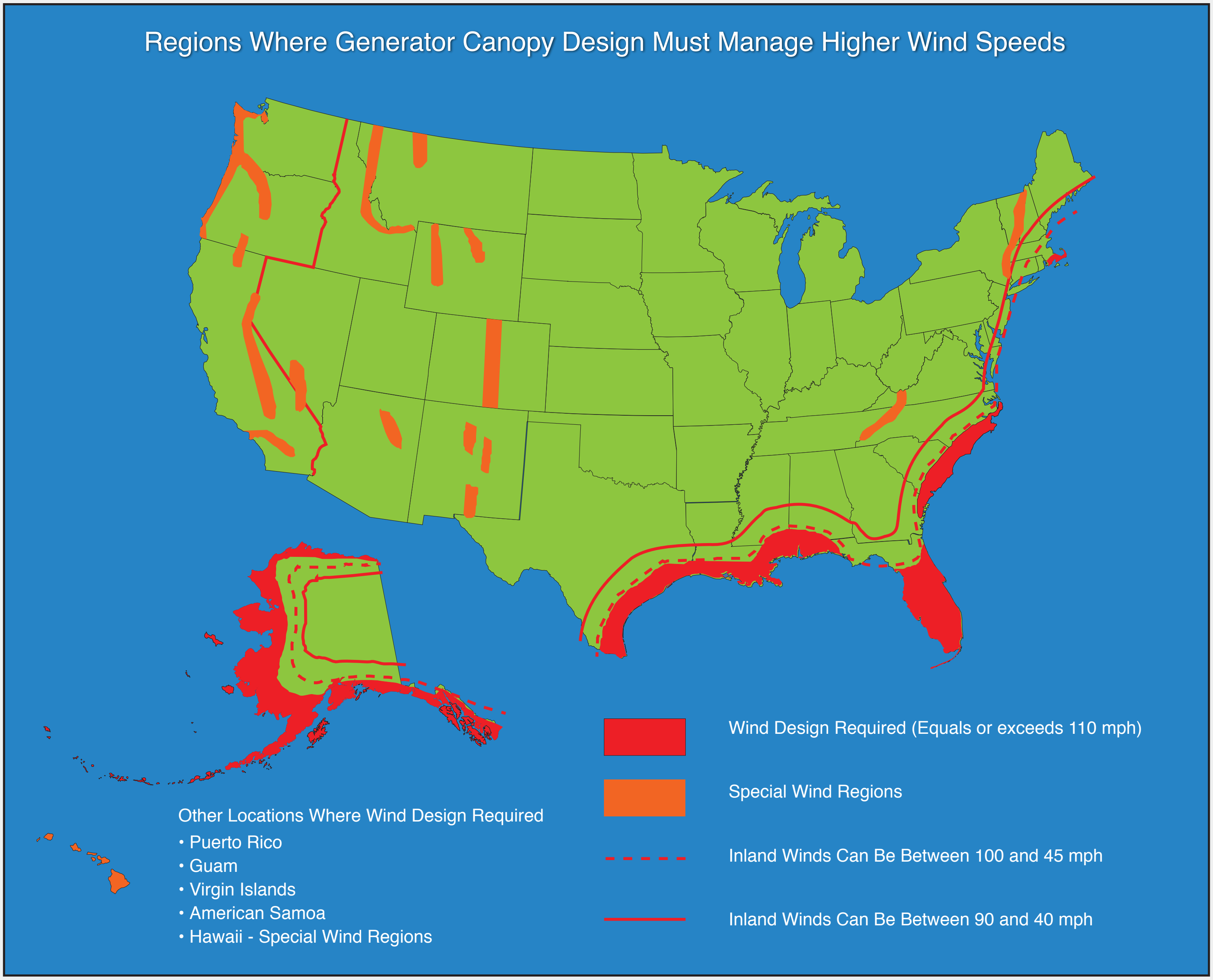
Generators Built to Withstand High Winds

1.0 Introduction:

A high percentage of power outages occur during major weather events. A significant weather event is high winds. The Federal Emergency Management Agency (FEMA) have conducted research into the effect high winds can have on power supply and have made recommendations to improve the ability of generator systems to manage extreme weather events.

Several FEMA studies make recommendations for generator sets mounted in enclosures that are installed in regions subject to high winds (hurricanes).

This Information Sheet discusses the special factors and planning that must be considered when supplying generators in enclosures that are installed outdoors in such regions.



To fulfill our commitment to be the leading supplier and preferred service provider in the Power Generation Industry, the Tradewinds Power Corp team maintains up-to-date technology and information standards on Power Industry changes, regulations and trends. As a service, our Information Sheets are circulated on a regular basis, to existing and potential Power Customers to maintain awareness of changes and developments in engineering standards, electrical codes, and technology impacting the Power Generation Industry.

2.0 High Wind Regions in North America:

The North American geographical areas that are identified as likely to be subject to high winds and/or hurricanes can be found within the diagram on page 1.

3.0 Hurricane Definition:

A hurricane can also be called: a tropical cyclone, typhoon, tropical depression, or tropical storm. A hurricane has wind speeds in excess of 74 mph (119 km/hr.) and is usually accompanied by heavy rain, thunder, and lightning.

4.0 Hurricane Formation:

A hurricane is a rapidly rotating storm system with a characteristic low-pressure center, a closed low-level atmospheric circulation, strong winds, and a spiral arrangement of thunderstorms that produce heavy rain. They typically form over large bodies of relatively warm water and derive energy through the evaporation of water from the ocean's surface which rises and ultimately re-condenses into clouds and rain when the moist air rises and cools to saturation.

Hurricanes can often have a diameter of 60 to 1,250 miles. Modern technology is used to follow any dangerous storm and notify the public of the storm so that preparations can be made in advance to protect lives.

5.0 Damage:

In addition to the wind damage to infrastructures, communications, buildings, homes, and transportation - with the additional problem of wind-borne debris, hurricanes can also cause a major storm surge along the coastal areas which increases the potential risk of flooding.

The loss of utility power service is common due to overhead power lines being damaged or knocked down by falling trees - hence the importance of having emergency generators available; both during the storm and especially during the subsequent cleanup period.

6.0 International Building Code (IBC):

The IBC provides standards for buildings and other structures which have been adopted by many states to ensure human life-safety and building protection during wind storms and seismic activity. The IBC 2012 edition increased the wind load rating from 90 mph to 105 mph, although rarely seen in practice except in the western states of California, Washington, and Oregon. Special regions, particularly along the Atlantic and Gulf Coasts, have ratings of up to 150 mph.

7.0 Wind Load:

The American Society of Civil Engineers (ASCE) 7-05 sets out minimum design loads for buildings and other structures. Compliance verification can be achieved by wind tunnel testing (not practical) which is most often done by the analytical method. The first step is to calculate the wind velocity pressure at the structure, which will be affected by the geography, local terrain, topography, wind direction, and the structure's occupancy factor. The latter allows for wide range factors dependent on the use. Uninhabited buildings have a lower safety factor than critical buildings such as hospitals, fire stations, etc. Elevated locations (like hilltops) or roof-top mounted generator enclosures require greater resilience and this must be taken into account in the calculations.

8.0 Enclosure Design:

The enclosure canopy must be manufactured of a material that will not buckle or collapse. This will require additional reinforcement, bracing and internal supports with appropriate fasteners. Most US generator manufacturers offer enclosures with wind load ratings to 150 mph, with a certification of compliance. Some even offer optional enclosures suitable for wind loads of 200 mph.

9.0 Generator Installation:

Anchors must be designed and rated to resist wind loading and are similar to those utilized for seismic loading to ensure that the generator remains connected to its foundation during the storm. The anchors must meet predetermined minimum depth with torque and spacing specified by the manufacturer as well as wide washers to obtain maximum load distribution.

10.0 Florida State Building Code (FBC) for High Velocity Hurricane Zones:

In accordance with ASCE 7-98, this code requires buildings and other structures to withstand high wind forces, with Miami-Dade and Broward counties having to withstand wind speeds of 146 mph and 140 mph respectively.

11.0 Useful Websites for Further Information:

National Hurricane Center/NOAA:	www.nhc.noaa.gov
International Building Code (IBC):	https://shop.iccsafe.org/
American Society of Civil Engineers:	www.asce.org
Florida Building Codes:	www.floridabuilding.org/fbc/publications/FBC.pdf

Miami, FL (Corp HQ)

5820 NW 84th Avenue
Miami, FL 33166
Phone: (305) 592-9745
Fax: (305) 592-7461
1-800-223-3289

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