

Technology Infrastructure

New Trends in Wind Turbine Generator (WTG), Towers
and O&M

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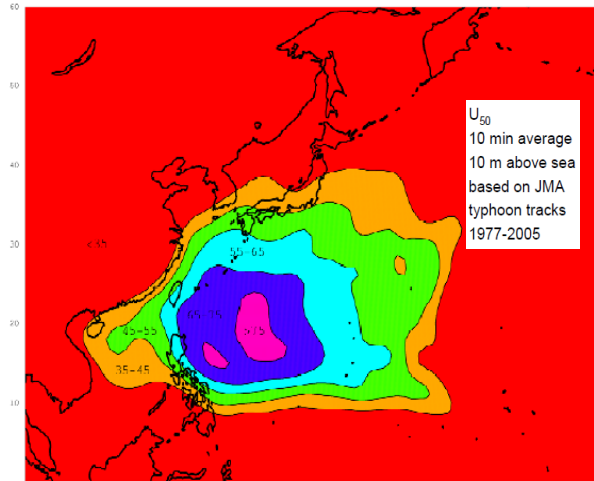
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General Site Condition in the Asian Region

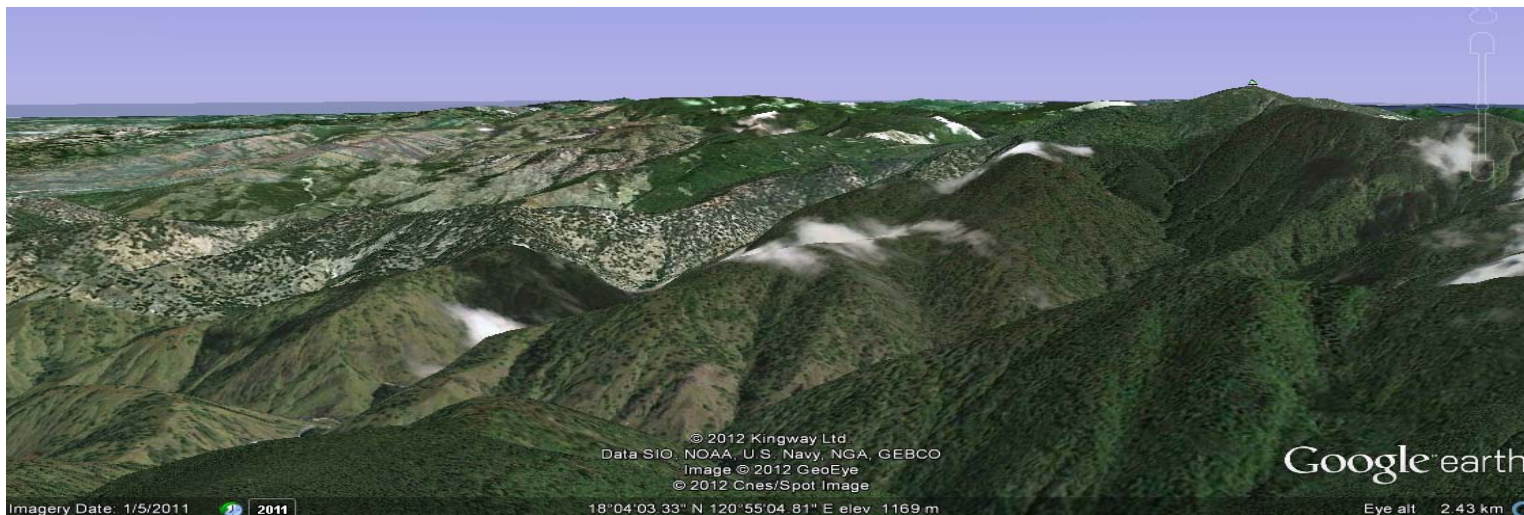
Extreme wind atlas for Western N Pacific



Source: 2006 Riso - DTU Study

- Higher extreme wind
- High turbulence sites due to terrain
- Transport and erection challenges due to mountainous topography
- Limitation in civil infrastructure
- Medium average wind speed

Sites with challenging terrain



Source: North Luzon, Philippines Google Earth Map

WTG Classification

Based on IEC 61400-1 standard:

WTG Class	I	II	III
Vref (m/s)	50	42.5	37.5
Ve50 (m/s)	70	59.5	52.5
Vave (m/s)	10	8.5	7.5
Turbulence Intensity	A = 0.18		
	B = 0.16		

WTG Technological Developments

- Lighter, more flexible and longer blades with increased load strength
- Use of permanent magnet direct drive technology
- Full Scale Frequency Converter
- Yaw control system with option for back-up generator for site specific application
- Condition monitoring on critical components of the turbine

Technological Developments in WTG Transport, Erection, Towers and O&M

- Use of pre-cast concrete or concrete-steel hybrid towers for taller and heavier turbines
- Different types of foundation are available
- Availability of bigger vessels for sea transport
- Mixture of barging and trucking for inland transport
- Single O&M provider for the whole wind farm
- Regional storage of spare parts
- 24/7 Remote Diagnostics services