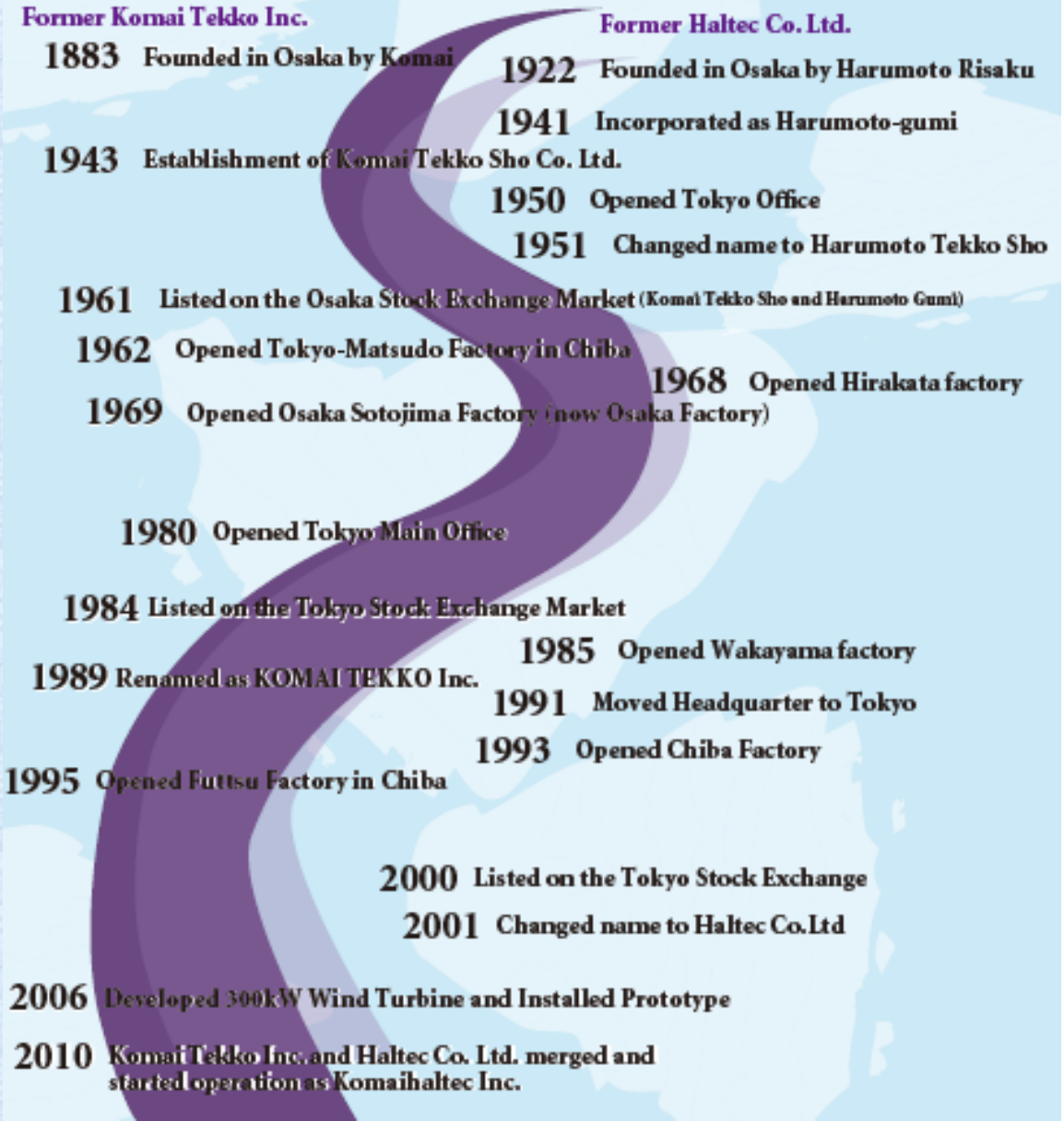
Cyclone Proof Model
300kW wind turbine

KOMAIHALTEC Inc.

Our Company: KOMAI HALTEC INC.



- Formerly Komai Tekko Inc. and Haltec Co. Ltd.
- More than100 years of experience in manufacturing steel structures.
- Bridge and Steel structure are main field of works
- Prototype 300kW wind turbine installed in 2006

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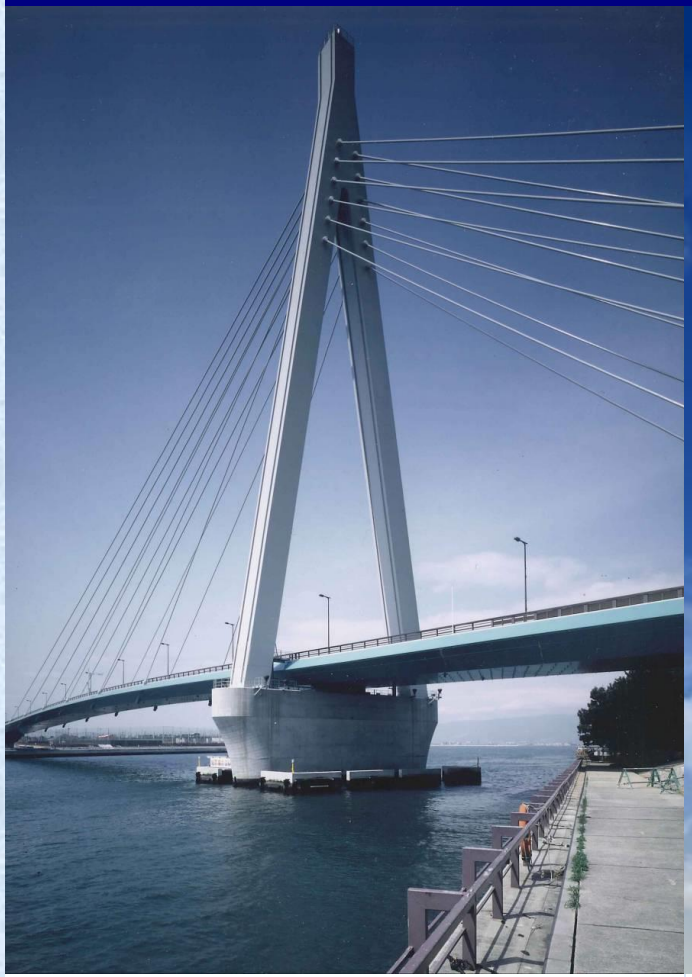


Steel Bridge Design, Fabrication and Installation

Steel Structure Fabrication

Wind Turbine and Sky Solar System

３００ｋW Wind Turbine：KWT300

COMPACT DESIGN

- Blade：16m
- Nacelle：18t
- Tower Height：41.5m
（4 blocks: each block 10t）
- Transportable w/ 10t trucks
- Erection with 60t cranes

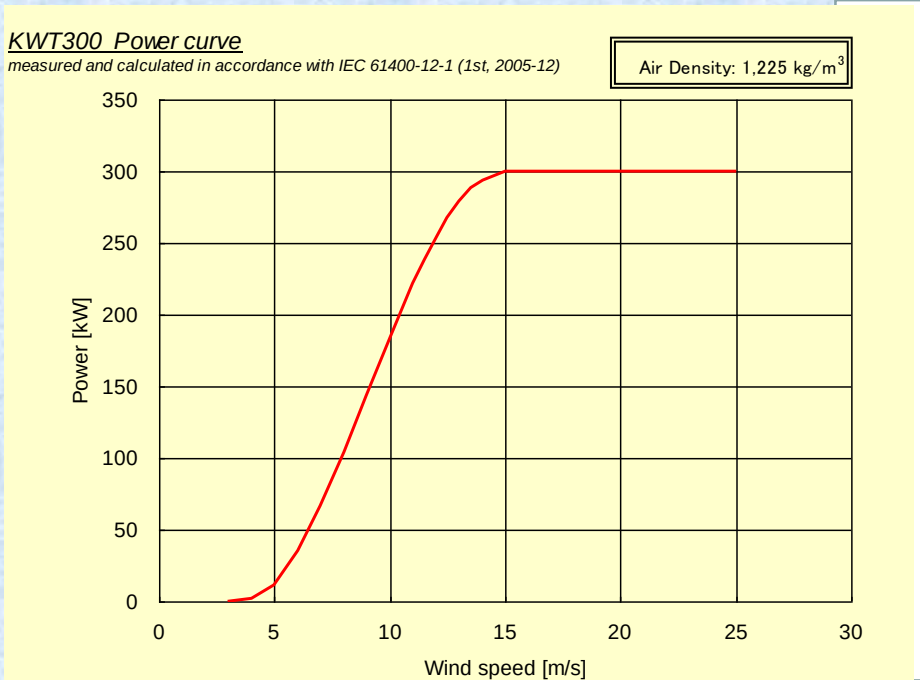
Micro-grid Friendly

- Flexible output control
  - Minimize battery storage
  - Customized control system
- Soft cut-in and cut-out

ROBUST

- Highest Turbulence Intensity
  - Durable on complex terrain
- Survival wind speed
  - 70m/s for standard model
  - 91.26m/s for typhoon resistant model

Performance and IEC Class



Cut in wind speed	3m/s
Rated wind speed	11.5 m/s (instant) 15 m/s (ten min average)
Cut out wind speed	25 m/s

IEC WTGS Class		I	II	III	S (KWT300)
Vref(m/s)		50	42.5	37.5	50
Vave(m/s)		10	8.5	7.5	8.5
Iref Turbulance Intensity	A	0.16	0.16	0.16	0.18
	B	0.14	0.14	0.14	
	C	0.12	0.12	0.12	

IEC Wind Turbine Class

Class II for average wind speed
Class I and above (typhoon model) for maximum wind speed
Class A + for Turbulence intensity

Output control of Wind Turbine for Micro Grid

Output control to mitigate the impact of grid frequency and voltage

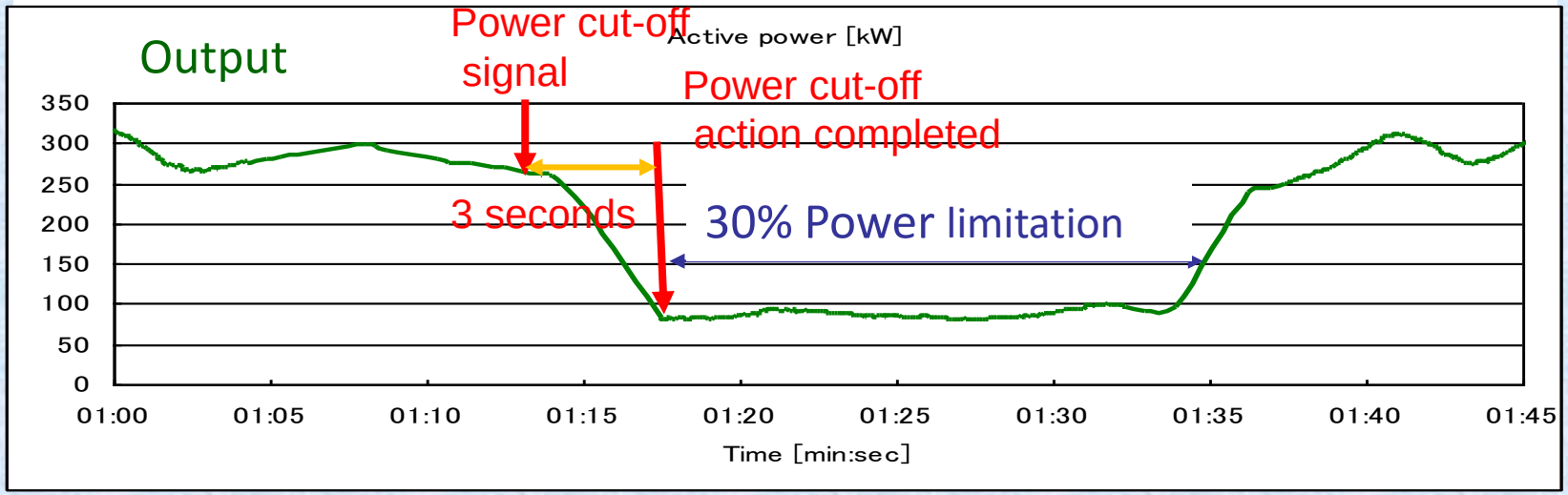
Reactive Power Control

Control range(Power Factor)
：cosφ=-0.86～0.86（φ＝±30°）・
Fixed value control：Use the fixed power factor
Variables control：Input value from the outside system (4-20mA)

Output control with blade pitch

Range ：10% ～100% of 300kW
By either
・Fixed value
・Input（Maximum value)
・Variables：Input from outside (4-20mA), Time control etc.

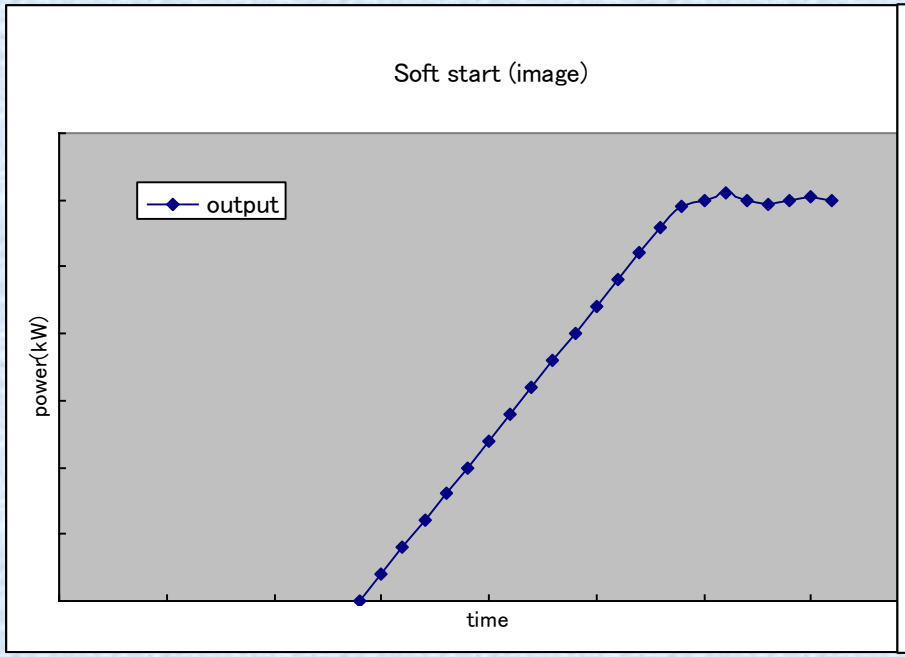
Test data for output power control

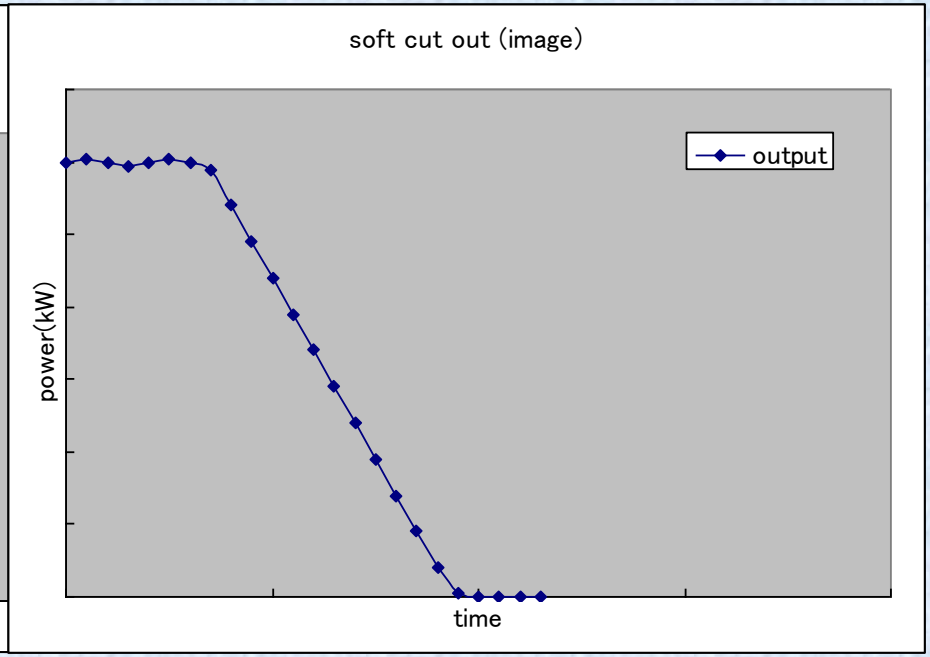


Output control of Wind Turbine for Micro grid

- Soft cut-in and Soft cut-out
- Limit the Output increasing speed by pitch control

to harmonize with diesel engines





Cyclone Proof Model

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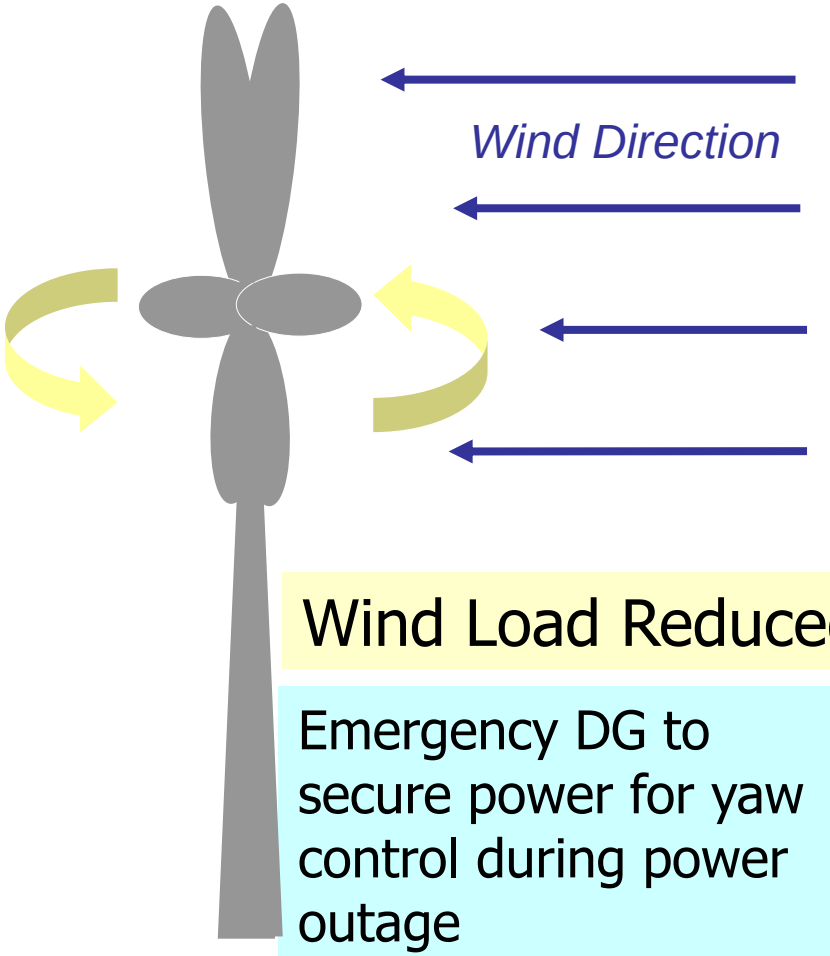
Key Features of "Type T"

Active Yaw Control keeps Rotor Down-wind Position



Wind Load Reduced

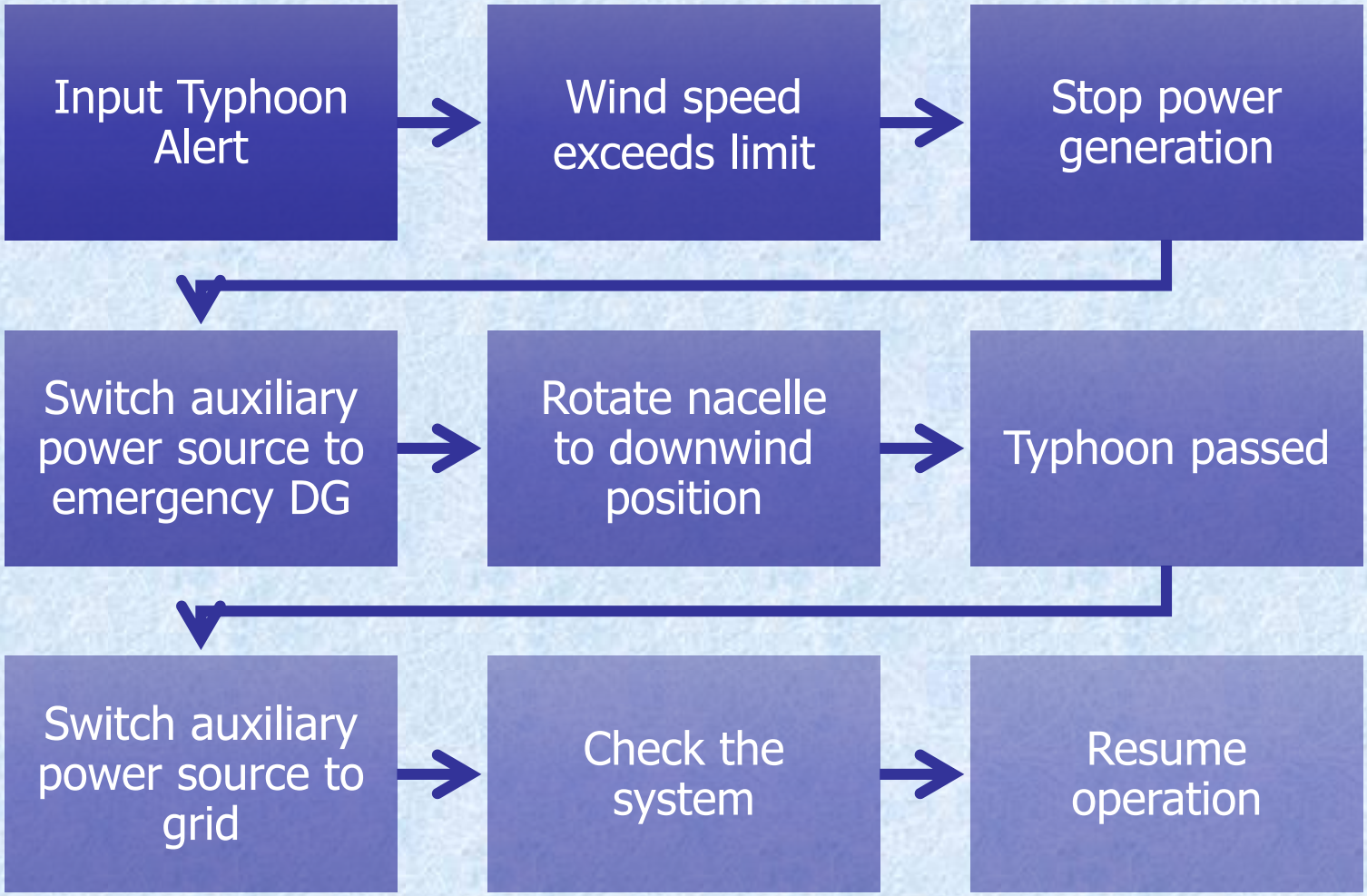
Emergency DG to secure power for yaw control during power outage

Item	Measures taken
Blades	Increased strength
Pitch System	Increased strength
Gear Box	Increased maximum bearable load
Tower	Increased strength

KWT300 Typhoon Model

	Standard Model	**Typhoon Model**
Cut-in Wind Speed	3.0m/s	
Cut-out Wind Speed	25.0m/s	
Maximum Wind Speed Vref (ten minutes average)	50m/s (111.8mph)	**58.5m/s** **(130.9mph)**
Survival Wind Speed, Ve50 (3 seconds average)	70m/s (156.6mph)	**91.26m/s** **(204.1mph)**
Control during Typhoon	Keep rotor up-wind position	Keep rotor down-wind position
		Active yaw control
In case of loss of grid power for auxiliary supply	No yaw control Designed to withstand the wind load from any direction	Supply power for yaw control with emergency power supply to keep the rotor position
Survival wind of wind censors	70m/s	100m/s
Nacelle cover survival wind	70m/s	91.26m/s

Flow of Typhoon Control



*If emergency DG is out of order when a typhoon approaches, and the power supply from the grid stops, the nacelle yaw will be controlled passively to keep downwind with half brake.

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Past Tropical Cyclone Experience

		(ten minutes average)				
Cyclone	Season	wind speed (mph)	wind speed (m/s)	Pressure	Affected area	Recorded max wind speed
Winston	2015–16	145	64.8	915 hPa (27.02 inHg)	Fiji	84.5m/s
Yolanda /Haiyan	2013	145	64.8	895hPa	Philippines	195mph 87.17m/s
Maemi	2003		55	910hPa	Miyakojima, Japan	86.6m/s

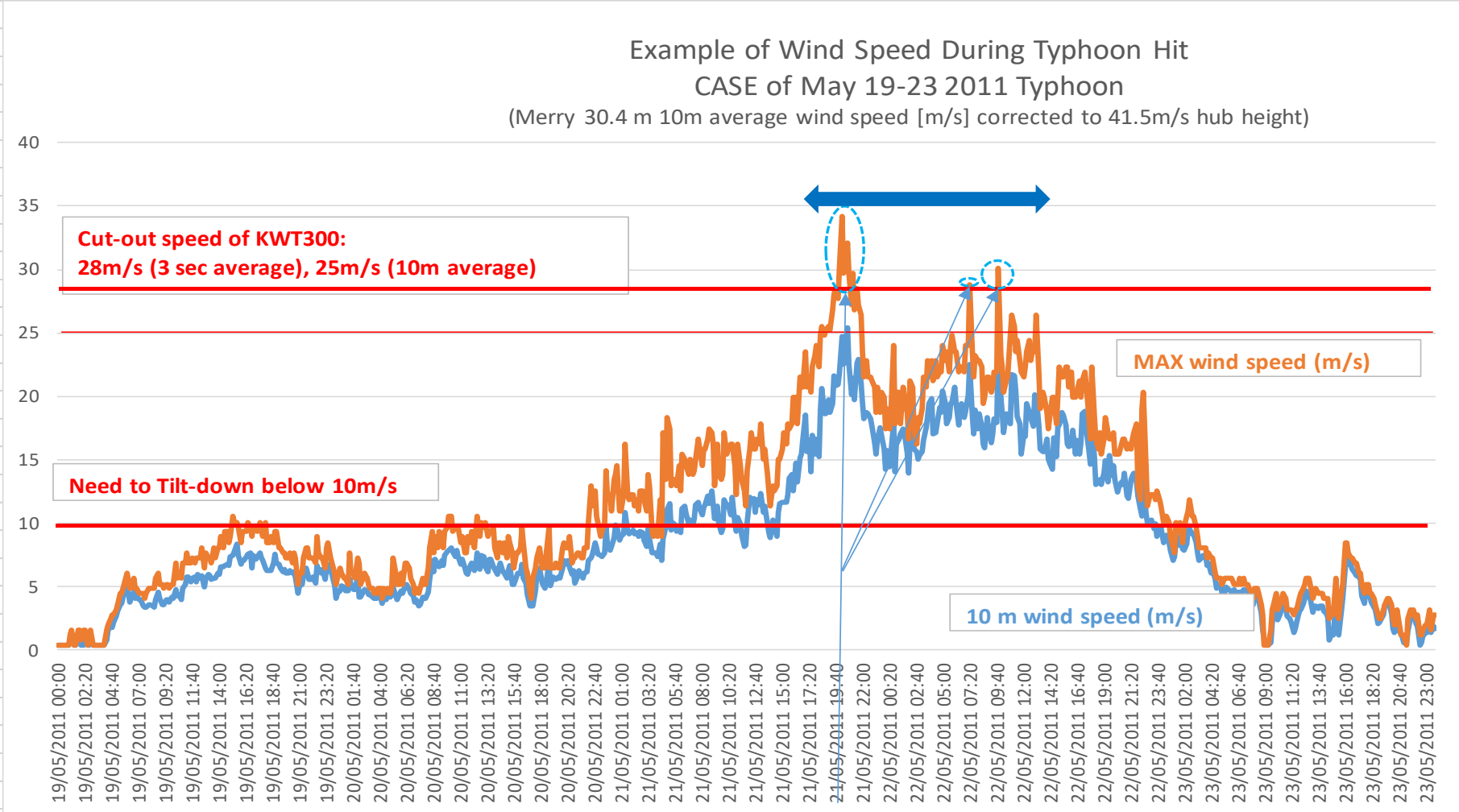
Tropical Cyclone Scale

Category	10min average wind speed (km/h)	(m/s)	Instant (3 sec) wind speed (km/h)	(m/s)
1	62 - 88	17.2 - 24.7	90 - 125	25.0 - 34.7
2	- 117	- 32.8	- 164	- 45.8
3	- 157	- 43.9	- 224	- 62.5
4	- 198	- 55.0	- 279	- 77.8
5	**>198**	**> 55.0**	**> 280**	**> 77.8**

KWT300 vs. Tilt-down type WT

	Komaihaltec's KWT300	Tilt-down type wind turbine
Transportation and Installation	60 ton crane required	25 ton crane Container transportation
Maintenance	- Climb inside the tower - No need to lower the nacelle - Less downtime due to maintenance	- Need to lower the system - More time consuming for maintenance
In case of typhoon	- Keep operation till the wind speed reaches 25 m/s - Safe against 70m/s wind as it is - Immediately Back to normal operation after typhoon - **Produce significant amount of energy**	- Need to lower before the wind speed reaches 10 m/s - Not much energy production

Wind Speed analysis during Typhoon



Total Shut-Down time for KWT300 = 20 hours

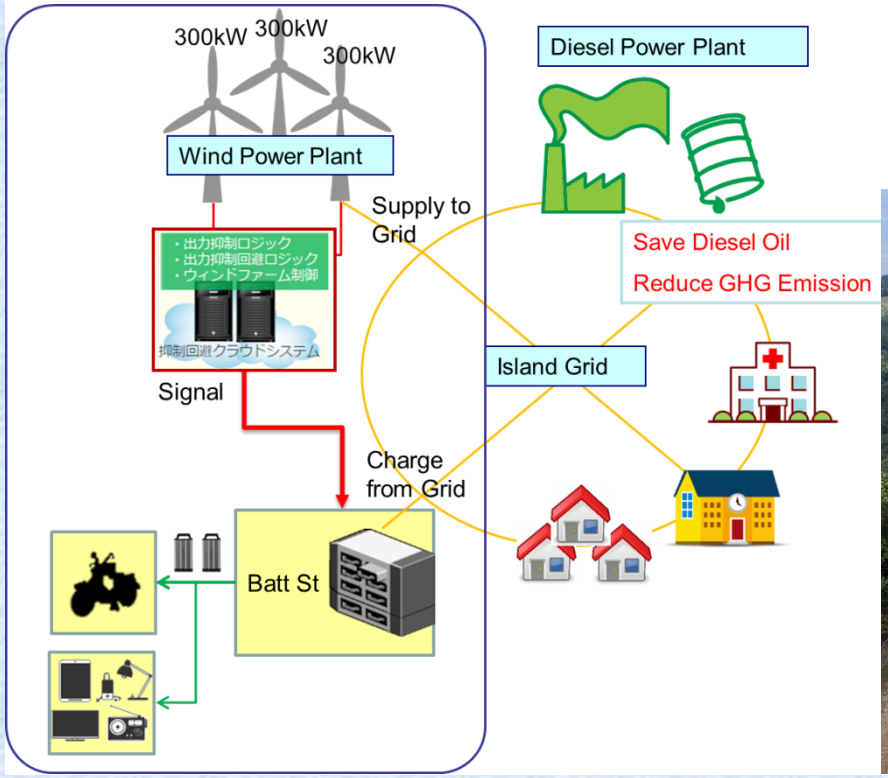
No Generation for 5 days with Tilt-down type

Example of Gain / Loss during Typhoon

	KWT300	Tilt-down type WT
Down time (case of May 2011 typhoon in Yap)	20 hours. Only when wind speed exceeds 25 m/s	5 days Half day for tiling down Stop from one or half day before wind becomes 10m/s, until one or half day after wind goes below 10m/s.
Energy generation	4 days generation for 3 units = 33,600kWh	NO Generation while on the ground.
Economic gain	33,600kW x 0.5 USD/kWh (diesel generation cost) x 3 times/year x 20 years life time **= 1 MUSD**	NO gain

Romblon Island Project (Philippines)

- **Typhoon resistant system pilot case**
- Partner: Romblon Electric Cooperatives
- Demonstration of surplus energy absorption by portable battery pack for EV (Honda Motors)
- To be commissioned in Dec 2018.



Other Projects （non-typhoon model）

・Oaxaca, Mexico
・UNDP project

・Niijima Island, Japan
・Island Micro Grid

・Wangdue Bhutan
・ADB project

・Kamchatka, Russia
・Cold Climate Model

・Fukushima, Japan
・Advanced Tech Institution

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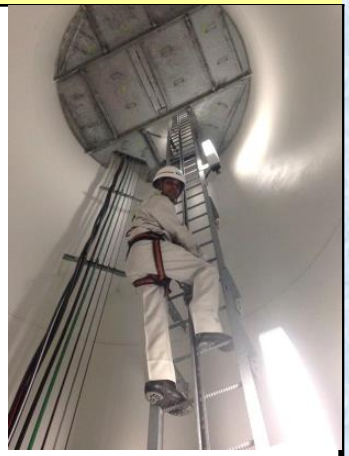
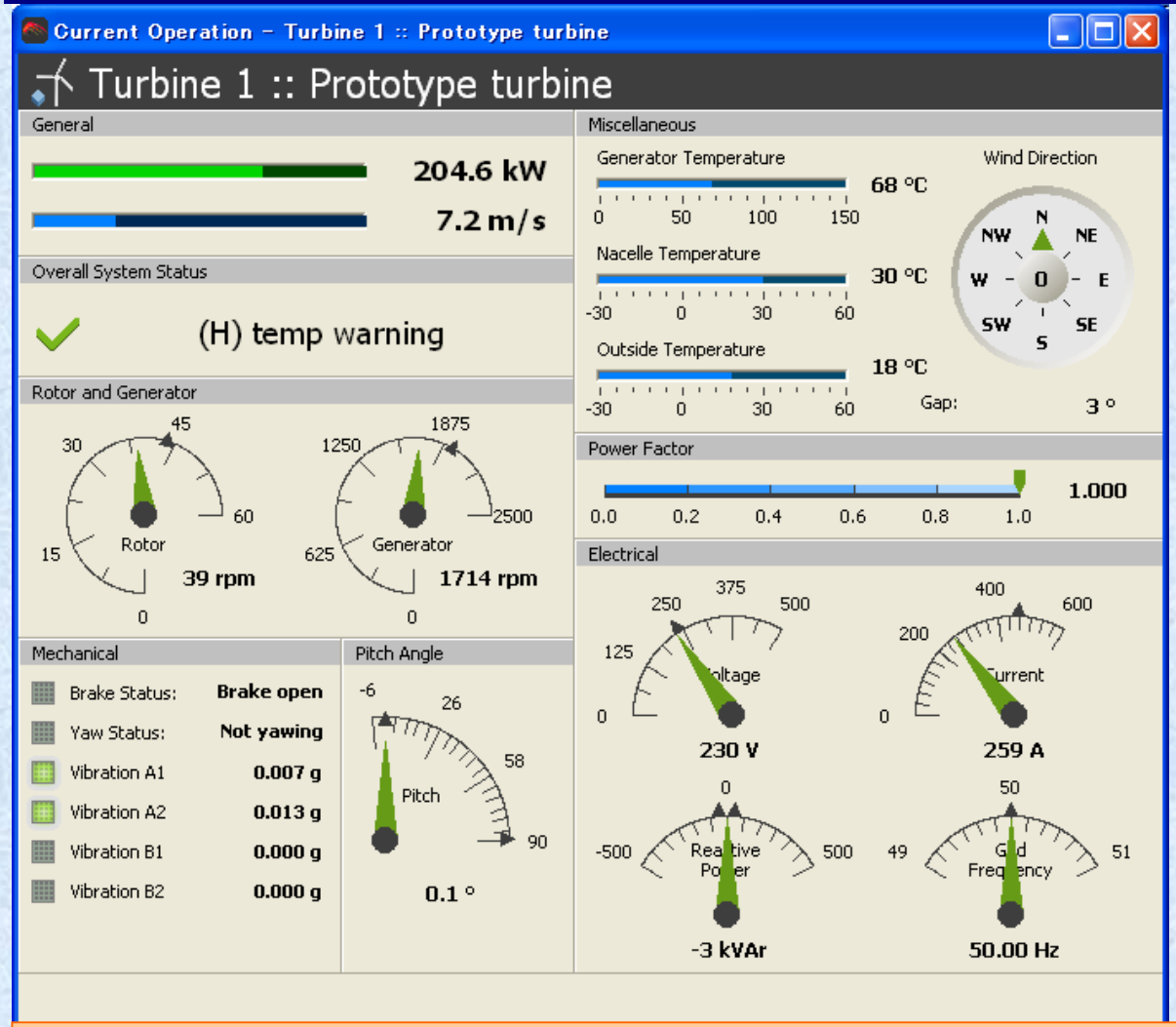
Maintenance of Wind Turbines

- **Scheduled maintenance is required for optimal and safe operation.**
- **Supplier's engineers or specialized maintenance servicer will conduct the maintenance, or trained local engineers take care of the normal maintenance**

Scheduled maintenance	Usually every half year. Refill, replacement of grease, oils, filters. Tightening bolts etc. NO NEED for cranes. Internal ladder to reach nacelle. 
Remote monitoring	Remotely check the operation status, errors, and operation logs.
Electrical inspection	Electrical inspection on Step-up transformer once a month designated by law. (in case of Japan)

Remote Monitoring for O&M Support



- Output
- Wind speed
- Rotation
- Voltage, Current
- Frequency
- Vibration
- Temperature

Komaihaltec checks the status and logs to provide technical support for O&M → Facilitate local maintenance

For more questions
Please contact
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