



Overview of SWT Development in Taiwan



Bureau of Standards, Metrology and Inspection



Taiwan Institute of Economic Research



Taiwan Small & Medium Wind Turbine Association

Oct., 2012



Outline

- **Overview of SWT market status**
- **Test lab status in Taiwan**
- **SWT standard development**





Overview of SWT market status



Current Status of SWT Industry in Taiwan

- System manufacturers (with own brand name and commercialized products) > 20
- Key parts and components suppliers > 10
- 100% domestically-made SWTs (<5kW) with strong supply chain
- Some institutes starts to develop 10kW~300kW turbines.
- Featured products are DIY assembled, mobile, foldable, wind-solar hybrid streetlights and environment integrated.
- Global pioneer in **Vertical-Axis Wind Turbine (VAWT)** technology



Hi Energy VAWT
EXPO at Shanghai



Power General VAWT
Flora Expo at Taiwan



Jetpro HAWT
Mobile base station

SWT Industry Outlook in Taiwan

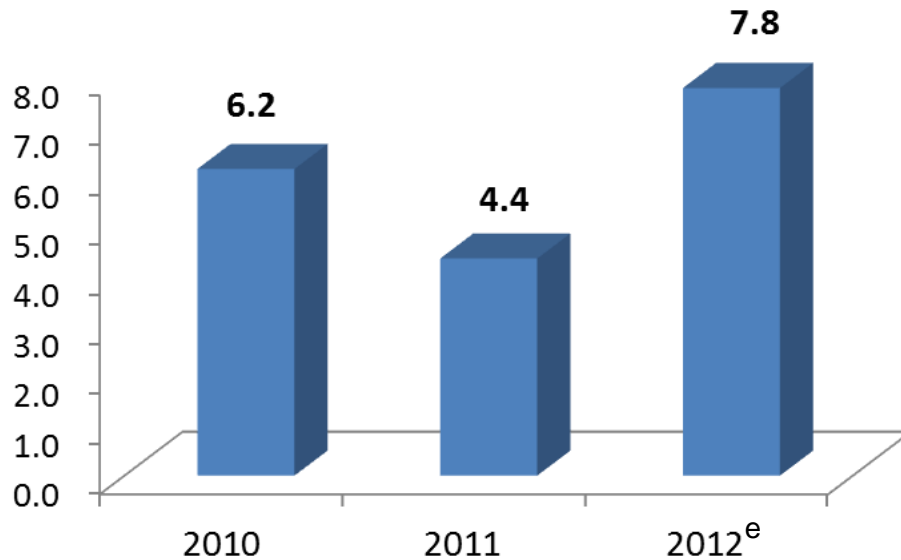
Type	Firm	Product Category	Business Model
VAWTs	Delta	300W, 1kW	Own brand
	i-wind	300W, 2kW, 4kW, 10kW*	Own brand
	GPM	200W*, 5kW	Own brand
	SIN TA	400W*	Own brand
	Fukuta	400W, 5kW	Own brand
	TECO	1kW	Own brand
	Compowe	100W, 300W, 500W, 1kW	Own brand
	Hi Energy VAWT	70W*, 300W, 1.5kW, 3kW	Own brand
	HOLY	1kw~3MW	Own brand
	AREA Green Energy	400W*	Own brand, OEM/ODM
	FUNG GIN DA	300W, 1kW, 3kW, 5kW	Own brand
Power General	300W, 1.5kW, 3kW	ODM	
HAWTs	Sunteck	3kW, 7.5kW	Own brand
	Delta	400W, 1kW, 3kW, 5kW	Own brand
	TECO	2kW, 3kW, 5kW*	Own brand
	Li Aye	300W, 1.5kW, 3kW, 5kW	OEM
	SIN TA	400W*, 2kW*	Own brand
	WindTek	2kW	Own brand
	Bultun	100W, 300W, 600W, 1.2kW	Own brand
	Jetpro	100W, 200W, 1kW, 5kW*	Own brand
	Spirox	2kW*	Own brand
	HOLY	1kw*~3MW*	Own brand
	AREA Green Energy	1kW*, 3kW*, 10kW*	Own brand, OEM/ODM
	Aerofortis	250W, 600W, 1.2kW, 3.5kW, 9.5kW*	ODM / Own brand
	Power General	400W, 600W, 1kW, 2kW, 3kW	ODM
Hetronix	2kW	Own brand	
INER	25kW, 150kW, 600kW*	Research Institute	

Note: * Product types under development.

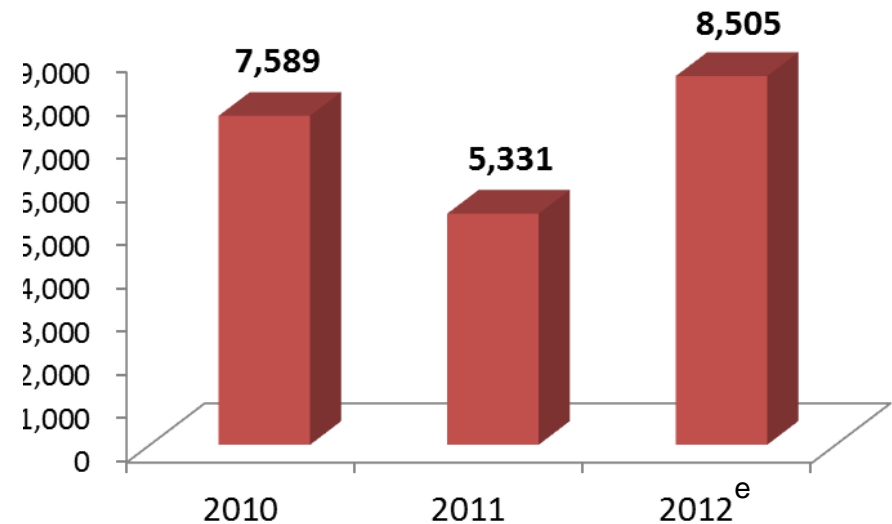
SWT industry in Taiwan

- Annual sales in 2011 is USD 4.4 million (5,331 units)
- VAWT accounts for 15.7% (in units)

Taiwan SWT sales
(in US million dollars)



Taiwan SWT sales (in Units)



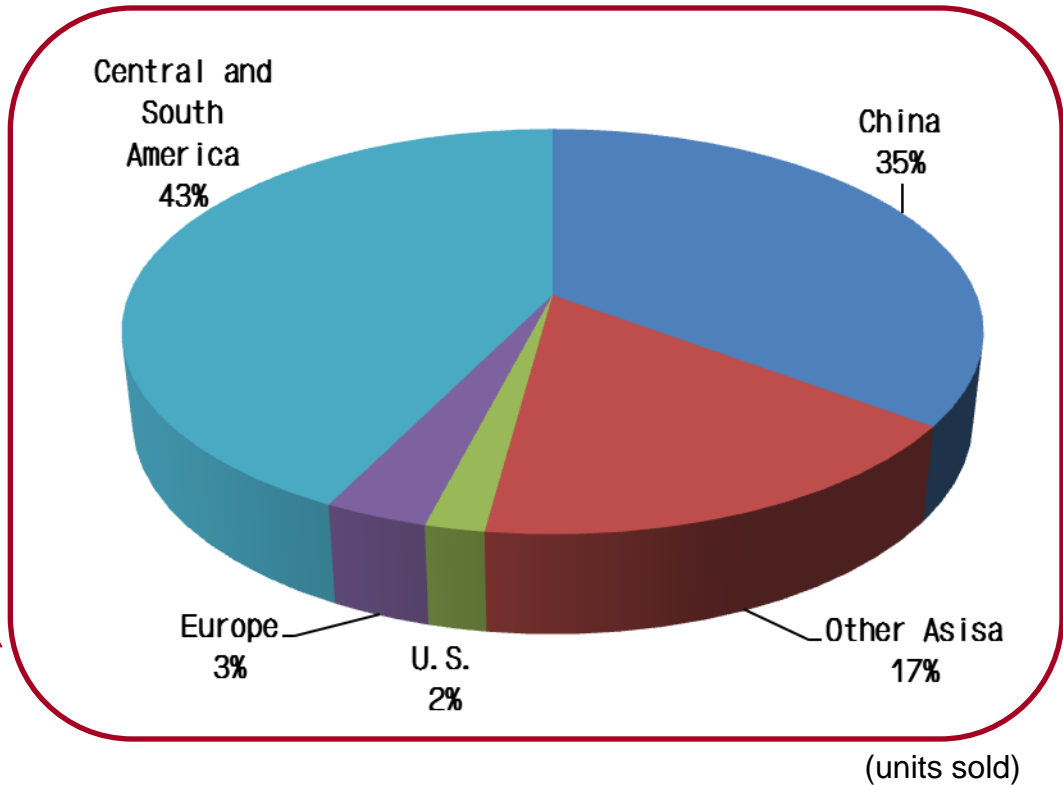
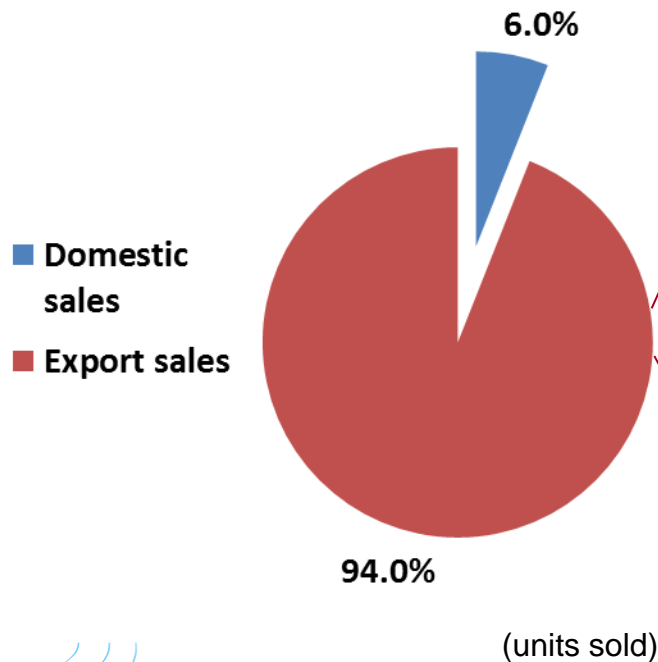
Remark: USD\$:NTD\$ = 1:30

Resource : TSWA 、TIER(2012.09)



Status of SWT Export in Taiwan

- Export sale accounts for **94%** in 2011
- Main export markets are Central and South America, China and other Asia.



Renewable Energy FiT in Taiwan

Category	Segment	Unit Size	FiT Year 2010	FiT year 2011	FiT year 2012
Wind	On-shore	1kW~10kW	\$0.24	\$0.25	\$0.25
		10kW above	\$0.08	\$0.09	\$0.09
	Off-Shore	-	\$0.14	\$0.19	\$0.19
Solar	Building-mounted (rooftop)	1kW~10kW	\$0.37	\$0.34	\$0.31
		10kW above to 100kW	\$0.43	\$0.31	\$0.28
		100kW above to 500kW	\$0.43	\$0.29	\$0.27
		500kW above	\$0.37	\$0.27	\$0.24
	Stand-alone	1kW and above	\$0.37	\$0.24	\$0.23
Hydroelectric	-	-	\$0.07	\$0.07	\$0.08
Geothermal	-	-	\$0.17	\$0.16	\$0.16
Biomass	Without anaerobic digestion	-	\$0.07	\$0.07	\$0.08
	With anaerobic digestion	-	\$0.07	\$0.07	\$0.09

Units: USD\$/kWh

Typical Products of Taiwanese SWT



Fukuta, 5kW



Hi Energy
VAWT



Power General,
VAWT+Streetlight



Bultun, HAWT



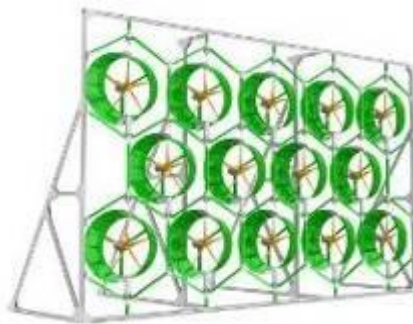
FUNG GIN DA
Barrel Type VAWT



Hi Energy
VAWT



Sin Ta
Wind-Solar hybrid
system



Jetpro,
HAWT Wall



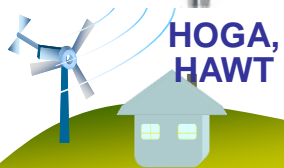
AREA Green Energy,
HAWT



Delta,
HAWT



GPM,
5kW VAWT



HOGA,
HAWT



Spirox
HAWT

Typical Wind-PV Hybrid Streetlights Products



Hi VAWT



GPM



i-Wind



AREA Green Energy



Bultun



Compowe



Jetpro

Diversified Application





Test lab status in Taiwan

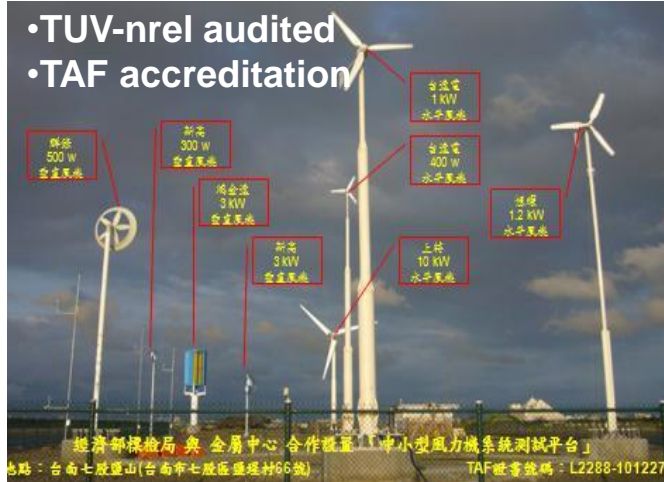


SWT Test Sites and Capabilities

- Metal Industries Research and Development Centre (MIRDC)
 - **Tainan Chigu test site**
 - 6~7 m/s annual average

- Taiwan Electric Research & Testing Center (TERTC)
 - **Nat. Penghu Univ. Test Site**
 - 9.7m/s annual average

- Institute of Nuclear Energy Research (INER)
 - **Dynamo test pad(180kW)**
 - **Design Evaluation**



- The Standard test site has been evaluated by the international certification:
 - Power performance measurements (IEC-61400-12-1)
 - Acoustic noise measurement techniques (IEC-61400-11 ed.2)
 - Duration test (IEC-61400-2 ed.2 Section 9.4)

- TAF accreditation is preparing for power performance, acoustic, & duration test
- 75kVA Inverter examination
- Standard for Interconnecting Distributed Resources with Electric Power Systems(UL-1741 and IEEE 1547)
- Set up Measurement and assessment of power quality characteristics of grid connected wind turbines by 2012 (IEC 61400-21) 、Lighting Protection(IEC 61400-24) 、Design and specification of gearboxes(ISO 81400-4)

- Driver train component Test
- Conduct the design certification of 25kW (IEC-61400-2) at 2009 and 150kW (IEC-61400-1) at 2010.
- Turbine strength and safety evaluation and overall design examination(IEC-61400-2)
- Preparing design evaluation international auditing



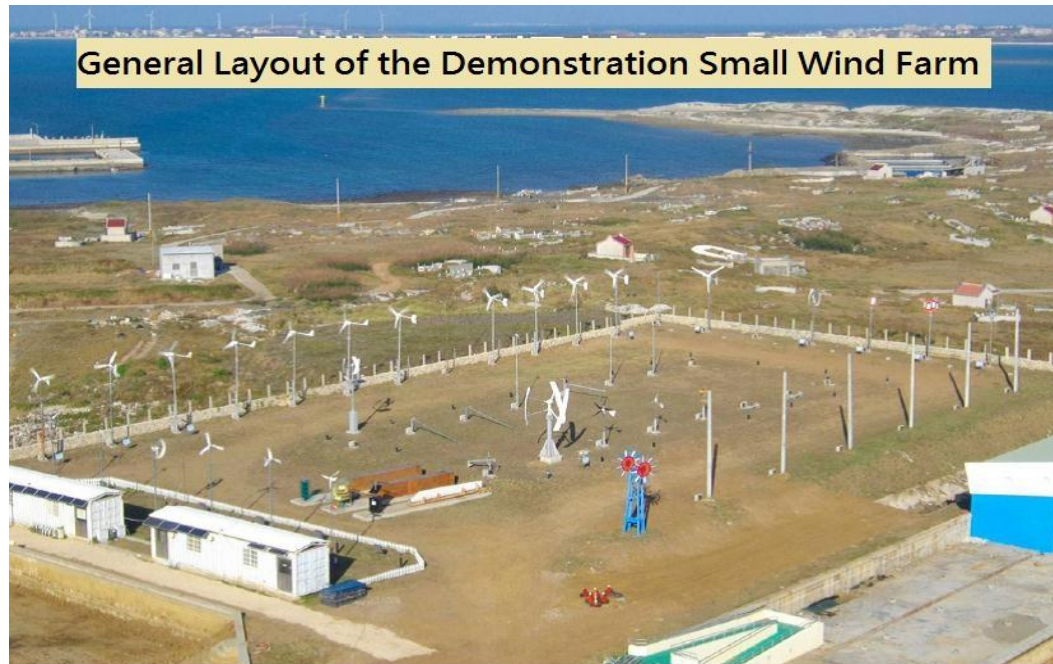
Subsidies for SWT Field Test

- To speed-up and support for the fulfillment of industrial park SWT tendering requirement
- Five SWT manufactures are subsidized (50% testing fee)
 - one 3kW VAWT
 - three 3kW HAWT
 - one 1.2kW HAWT
- Test Site
 - Tainan Chigu
- Status
 - Expecting all 5 SWTs completing TAF certified testing report in Feb., 2013



Initiating on SWT Demonstration Wind Farm

- Design Target – 100 kW
- Flat field or combinations with some buildings
- Land freely offered by city or county government
- Demonstration for FIT policy, SWT business model, SWT show window





SWT standard development



Cross-Strait SWT Cooperation

- Contact windows – China-CWEA and Taiwan-TSWA
- Starting to formulate mutual recognition mechanism for SWT standards and a joint testing and certification platform
- Developing “The Cross-Strait Standard for VAWT” as the first step

Cross-strait SWT Joint Standard Development Task Force

Industrial Advising Committee- formulate the working plan and organization coordination.

- **Chairman of Chinese Wind Energy Association (China)**
- **General Secretary of Chinese Wind Energy Equipment Association (China)**
- **General Secretary of National Technical Committee for Wind Machinery Standardization (China)**
- **President of Taiwan Small & Medium Wind Turbine Association (Taiwan)**
- **General Secretary of Taiwan Small & Medium Wind Turbine Association (Taiwan)**

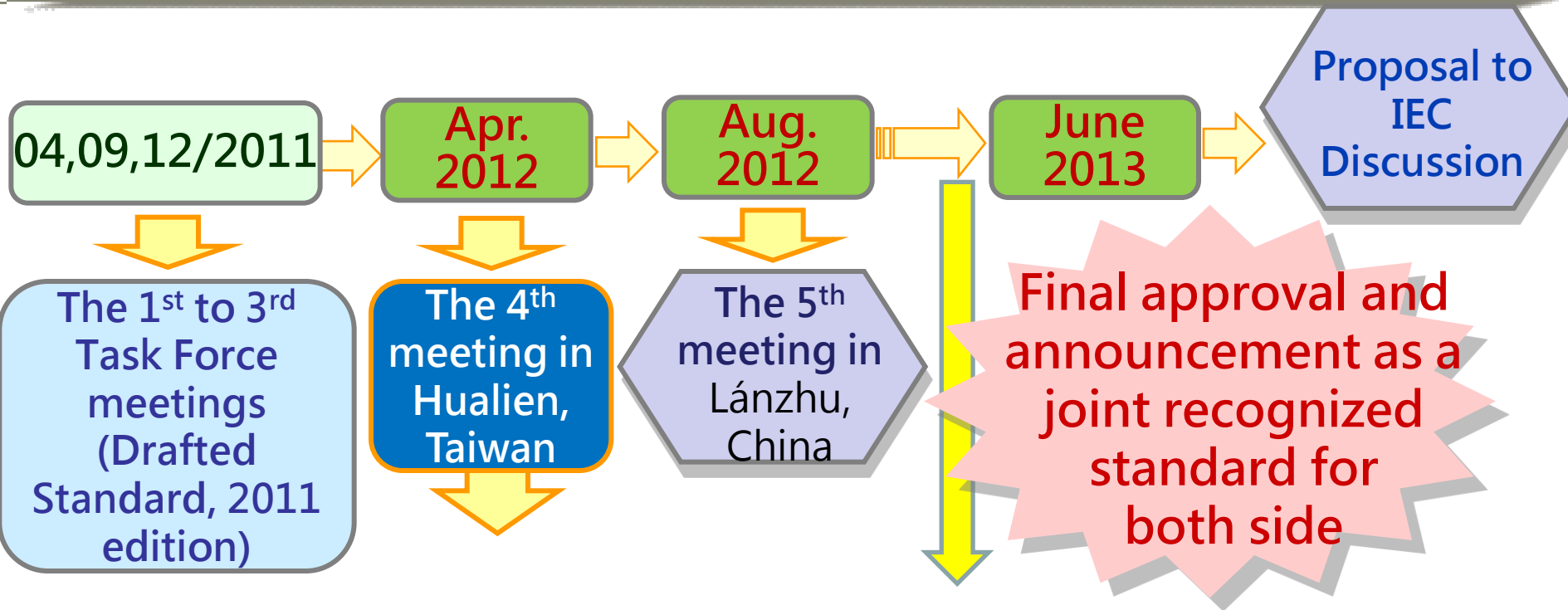
Standard-setting Group

Test Group

Certification Group

Industrial information and international cooperation group

Task Force Meeting and VAWT Standard



- Circulation for public review has completed
- Sep.~ Oct. 2012, Technical committee review in progress
- Nov. 2012, Final check for consistency w.r.t. technical concerns
- Dec. 2012, Developing English version
- Sep. 2012~June 2013, **Cross-Strait VAWT field test & inter-comparison Study**
- Feb. 2013, Final meeting in Taipei



Cross-Strait VAWT Field Test &. Inter-comparison project

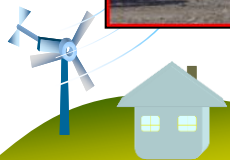
- Collecting data for justifying adaptability of the standard
- Project period – Sep. 2012 ~ Mar. 2013
- Test site – Penhu Univ. zone D

Hi-VAWT
Technology
Corp. (Taiwan)



DS-3000	Type	CXF1000
<u>Darrius+Sov.</u>		<u>Maglev Darrius+Sov.</u>
3kW	Rated Output	1kW
12m/s	Rated Wind speed	13m/s
200rpm	Rated Rot. Speed	-
< 3m/s	Cut-in	3m/s
15m/s	Cut-out	15m/s
60m/s	Survival	60m/s
On-grid	Output Connection	Off-grid

Timar Scenery
Energy Technology
Co., Ltd. (China)




Discussion

- **The market status of small wind in Australia**
- **The promoting experience for small wind turbine testing, technical standards and consumer labeling**
- **Possible cooperation for small wind turbine industry of Taiwan and Australia**




Thanks for your Attention




TSWA
台灣中小型風力機發展協會
Taiwan Small & Medium Wind
Turbine Association
<http://www.small-wind.org.tw/>
TEL: 886-2-2586-5000 #904, 995


- Unite the Small Wind Industry from Upstream to Downstream




100W~50kW Wind Turbine




- Solar / Wind Hybrid Street Light



- Roof Mounted / Marine Small Wind System



- Community Scale / Landscape Integrated Small Wind System



Draft Contents of VAWT Standard

「The Cross-Strait Joint VAWT Standard」 - 11 Chapters, 17 Sections and 29 Subsections

1. Scope

2. Normative References

3. Definitions

3.1 The Vertical Axis Wind Turbine (VAWT) Generating System

3.2 Key Components

3.2.1 VAWT Rotor

3.2.2 Generator

3.2.3 Controller

3.2.4 Inverter

3.2.5 Supporting Structure

3.3 The Swept Area of VAWT

3.4 The Hub Height of VAWT

4. Technical Requirements

4.1 Scope of the Requirements

4.2 General Requirements

4.2.1 Classes of VAWT

4.2.2 Operation Conditions

4.2.3 Basic Performance Indicators

4.2.4 Basic Safety Functions

4.3 Performance Requirement

4.4 Durability and Operation Availability Requirement

4.5 Acoustic Sound Requirement

4.6 Supporting Tower and Foundation Requirements

4.6.1 Supporting Structure Design Considerations

4.6.2 Exempted Supporting Structure

4.6.3 Supporting Structure Conforming with Building Codes

4.6.4 Supporting Structure and Maintenance

4.6.5 Supporting Structure Resonance Vibration

4.7 Controller and Inverter Requirement

4.8 Considerations of Power Quality

4.9 Considerations of EMC

4.9.1 Generator EMC

4.9.2 Controller EMC

5. Testing

5.1 Testing Sites

5.1.1 Field Site Testing

5.1.2 Testing not under Field Site

5.2 System Testing

5.2.1 Power Performance Test

5.2.2 Duration Test

5.2.3 Acoustic Sound Test

5.2.4 Strength Evaluation and Safety/Function Test for System

5.2.5 Strength Evaluation and Test for Blade and its Affiliated Structures

5.3 Generator Testing

5.3.1 Generator Rated Power and Performance Index

5.3.2 Generator Durability Test

5.3.3 Generator Shell and its Supporting Structure

5.4 Controller and Inverter Testing

5.4.1 Controller and Inverter Safety Test

5.4.2 Inverter Electrical Characteristic Test

5.4.3 Control Function Test

6. The Protection of Wind Turbine System Appearance

7. Deposition and Transportation of Wind Turbine System

8. Assembly and Installation

9. Operation and Maintenance

10. Wind Turbine Markings

11. Documentation Requirements

Annex A. Listing of Annex H Statements of IEC 61400-12-1

Annex B. Simplified Load Calculation Model for VAWT (Informative)