SMALL WIND TURBINES

SMALL WIND TURBINES' APPLICATIONS

ACSA wind turbines do not need a grid to operate. So, they are very well suited for autonomous, stand-alone operation. They are there fore a viable alternative for diesel generator sets, because there don't depend on the fuel, and also they do not need regular maintenance, because they generate electricity without any charge on the environment. Among other usages, they are especially recommended for:

- Electric supply of isolated houses and public services. Houses set in isolated areas, mountain shelters, etc…
- Electric supply for either small agricultural or industrial resorts.
- Pumping up water, watering systems, either farms or greenhouses lighting, milking systems, refrigeration, etc.
- Desalination and waste water treatment.
- Ice-making
- Telecommunications, maritime marking, lighthouses, radio repeaters, television and alarm devices, etc...

The small wind turbine can be integrated into a mixed plant, equipped with photovoltaic solar panels or diesel groups to get a better performance and security for the supply. If the energetic demand increases over the initial foresight, the generative and accumulative capacity would be easily extensible.

This kind of resorts can be directly attended by its owners since the required maintenance effort is quite simple.

Prior to considering both the acquisition and installation of one of these supply systems, at least the average wind speed at the concerning location should be known, as well as the electricity characteristics (max. Power and number of kWh/year).

ACSA will be pleased to assist potential buyers with the selection of the wind turbine type, which is best suited for their needs.

EVALUATIVE PROCEDURES

- **Evaluation of the Wind Potencial of the Location.**

The energetic potential will depend on the wind background of the place. It is recommended to do the appropriate measures to understand the wind behaviour and its characteristics:

- Distribution of both wind speed and direction frequencies.
- Distribution of annual rate speed
- Height- dependant wind variation
- Topographic influences
- Gust rates. Maximum values

For small plants it is required the data concerning to both wind speed and annual average frequency, obtained, of course, from the location of the wind turbine.

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Measuring the average speed of the location can be obtained by following several methods:

- Directly, using anemometers that register wind speed.

- Indirectly, using information from nearby locations such as either wind registers from forecasting stations or the Beaufort reduced scale, as it is shown below::

Nº Beaufort	Wind Speed		General Description	Land Criteria
	Km/h	m/s		
0	0/0,7	0/0,2	Calm	Smoke raises vertically.
1	1/5	0,3/1,5	Light Air	Smoke tilts but weather vains are still.
2	6/11	1,6/3,3	Light Breeze	Notorious wind over the face. Leaves move and weather vains rotate.
3	12/19	3,4/5,4	Soft Breeze	Leaves and branches in a continuous motion. Flags wave.
4	20/28	5,5/7,9	Moderated Breeze	Dust and papers rise. Small branches shake.
5	29/38	8,0/10,7	Cool Breeze	Small trees wave. Waves appear in ponds.
6	39/49	10,8/13,8	Strong Breeze	Big branches shake. Wirings vibrate.
7	50/61	13,9/17,1	Moderated	WindTrees shake. Facing the wind is uncomfortable
8	62/74	17,2/20,7	Cool Wind	Small branches crack. Difficult to walk facing the wind.

- **Energetic Demand of the Location.**

In order to obtain the best benefit from the energy produced in the windiest seasons, using it in calm or less profitable times, it is necessary to arrange an appropriate energy storage. The most extended and recommended systems of accumulation are the electric accumulators or batteries.

User must evaluate his energetic necessities beforehand in order to measure correctly the storage capacity of the batteries, the regulator and the reverser. For this purpose, it is also necessary to know both the top and the average power required; for it, it is necessary to take into account which devices are fed with electric energy from the batteries, whether they work simultaneously, and the usage time table. If we multiply the power of each device by the operative time, we will obtain the daily energetic consumption.

The generation system based on Small Wind Turbines, if installed in a location with enough wind rate, is capable of continuously supply electricity for a house, an industry or several other uses but only if the system has been well calculate. It may satisfy the needs of calm season to a bigger or lesser extent, depending always on both the energetic consumption of that period and the existing accumulative capacity of the batteries. However, in order to optimize the installation, we should avoid the use of household appliances requiring an excessive consumption of energy such as electric stoves or thermostats.

SYSTEM DESCRIPTION

- **Small Wind Turbine:**

The small wind turbine rotor is composed by three blades anchored to a steel base named axle box, directly joint to the generator. This way it can generate energy in a controlled amount of revolutions, becoming unnecessary the use of a gearbox and thus avoiding further maintenance. The tower used can be either tubular or lattice-shaped with guys or self-subjections, its height varies between 6 and 18 meters.

- **Regulator and Accumulation System:**

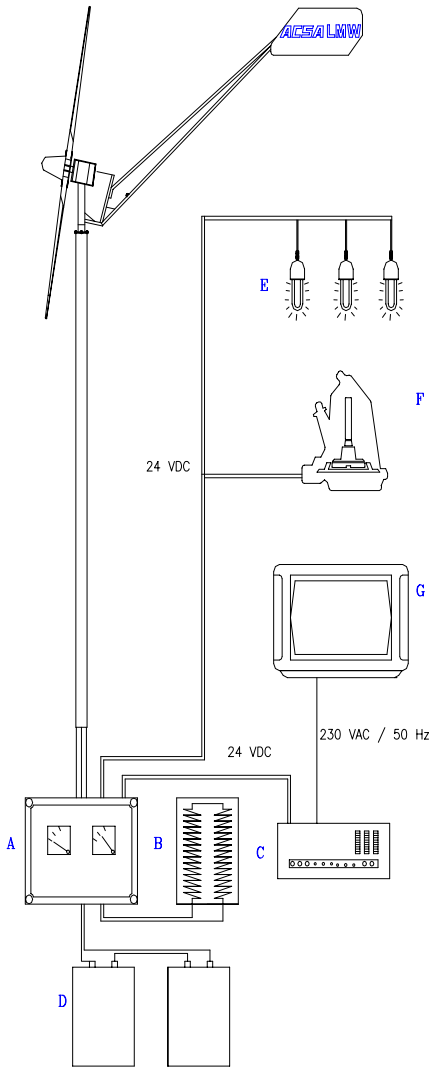
As the supply and the demand may vary, the three-phasic current supplied by the generator is rectified in the tension controller or in the regulator, turning it into direct energy before being stored in 12V, 24V, 48V or 120V batteries. Batteries energy can be directly used to feed any direct current electric equipment using this same voltage. The regulator is in charge of maintaining the battery connected while the tension in terminals of the rectifier were between certain value order. Besides it controls the batteries charging level, avoiding overloadings and overunloadings that may reduce its effective life. In order to alleviate overloadings, it shunts the current towards dissipation resistances.

- **Reverser:**

Apart from the direct consumption, it is also possible to obtain again 110V or 220V to 50/60 Hz alternating energy, by the use of a reverser, that is an electronic commutation system that transforms batteries direct current into alternating current.

INSTALLATION SCHEME

The following scheme shows a standard installation, with small wind turbine generation:



A Control unit
B Dump load
C Inverter
D Batteries
E 24 VDC appliances

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=Example 1: Hybrid system using a turbine LMW 1000 combined with 456 Wp' solar panels generating unit of 2 kcVa.

Project carried out in the Netherlands.

< Example 2:

Several Mauritanians' tribes are equipped with "Batteries loading points" LMW 1003/1500.

The villagers get on well with the person in charge of the eolic system replacing their empty batteries by charged ones.

>Example 3:

33 miniturbines LMW, type 1003 and 2500, generating 220 VAC/50 Hz providing electricity to 2 villages.

<Example 4:

22 miniturbines LMW, type 1003, for the electrification of isolated tribes in the Himalayas.

Production of 220 VCA/50 Hz. Project carried out in India.

ACSA-LMW delivers a wide range of windturbines: ACSA-LMW-250, ACSA-LMW-600, ACSA-LMW-1000, ACSA-LMW-1500, ACSA-LMW-2000, ACSA-LMW-3000, y ACSA-LMW-10000

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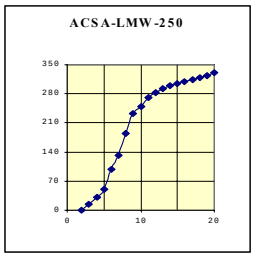
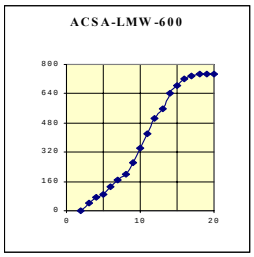
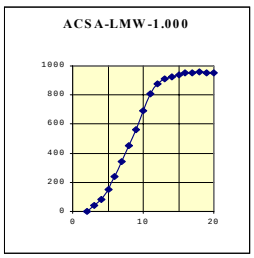
	ACSA-LMW-250	ACSA-LMW-600	ACSA-LMW-1.000
POWER rated/máx.	250 / 330 W	600 / 750 W	750 / 1.000 W
WIND SPEED cut-in / rated / survival	3 / 10 / 60 m/s	3 / 12 / 60 m/s	2,5 / 10,5 / 60 m/s
ROTOR SPEED rated/máx.	620 / 1.300 r.p.m.	680 / 1.000 r.p.m.	450 / 775 r.p.m.
ROTOR number of blades diameter rotor surface blades material airfoil position	3 1,7 m 2,27 m^2 Polyester or reinforced épóxy with fiberglass Göttingen 417 A up-wind	2 2,2 m 3,80 m^2 Polyester or reinforced épóxy with fiberglass Clark Y up-wind	3 3,12 m 7,65 m^2 Polyester or reinforced épóxy with fiberglass or carbon NACA 4415 up-wind
GENERATOR type number of poles rated voltage frecuency	Gearless/Brushless permanent amgnet alternator 12 12 / 24 VAC 0-130 Hz	Gearless/Brushless permanent amgnet alternator 12 12 / 24 VAC 0-100 Hz	Gearless/Brushless permanent amgnet alternator 12 12 / 24 / 120 VAC 0-75 Hz
VOLTAGE CONTROL	Type MP 25A-12/24V or similar, with rectifier, charging voltage controller and dump load.	MP type / ARK similar 60A-12V or 25A-24V,ou, with rectifier,charging voltage controller and dump load.	MP type / ARK similar 60A-12V or 25A-24V,ou, with rectifier,charging voltage controller and dump load.
POWER CONTROL	Hinged tail vane	Hinged tail vane	Hinged tail vane
YAW SYSTEM	Passive by tale	Passive by tale	Passive by tale
BRAKE SYSTEM	None	None / Switch of electric brakes in the regulator	None / Switch of electric brakes in the regulator
TOWER	Galvanized steel tube Guyed tower 6-12 m	Galvanized steel tube Guyed tower 6-12 m	Galvanized steel tube Guyed tower 6-12 m
ANUAL YIELD **Average wind speed** 4 m/s 5 m/s 6 m/s 7 m/s 8 m/s	kWh/yr. 305 525 750 945 1.105	kWh/yr. 580 975 1.420 1.855 2.240	kWh/yr. 1.060 1.755 2.480 3.180 3.815







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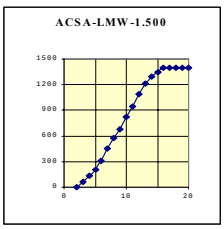
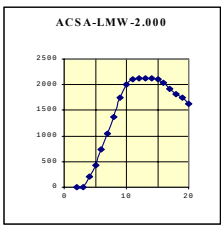
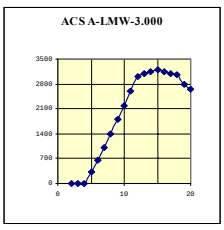
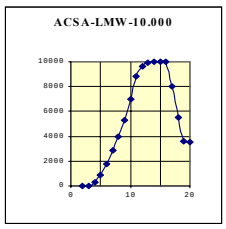
	ACSA-LMW-1.500	ACSA-LMW-2.000	ACSA-LMW-3.000	ACSA-LMW-10.000
POWER rated/máx.	1.000 / 1.400 W	2.000 / 2.400 W	3.000 / 3.200 W	10 / 10 kW
WIND SPEED cut-in / rated / survival	2,5 / 10,5 / 60 m/s	3 / 10 / 60 m/s	4 / 12 / 60 m/s	3 / 13 / 60 m/s
ROTOR SPEED rated/máx.	470 / 800 r.p.m.	225 / 360 r.p.m.	265 / 350 r.p.m.	280 / 350 r.p.m.
ROTOR number of blades diameter rotor surface blade material airfoil position	3 3,12 m 7,65 m^2 Polyester or reinforced épóxy with fiberglass or carbon NACA 4415 up-wind	3 5 m 19,63 m^2 Polyester or reinforced épóxy with fiberglass NACA 4415 up-wind	3 5 m 19,63 m^2 Polyester or reinforced épóxy with fiberglass NACA 4415 up-wind	3 7 m 38,48 m^2 Polyester or reinforced épóxy with fiberglass NLF 416 up-wind
GENERATOR type number of poles rated voltage frecuency	Gearless / brushless permanenet magnet altenator 12 12 / 24 / 120 VAC 0-80 Hz	Gearless / brushless permanenet magnet altenator 18 24 / 48 / 120 VAC 0-54 Hz	Gearless / brushless permanenet magnet altenator 18 24 / 48 / 120 VAC 0-53 Hz	Gearless / brushless permanenet magnet altenator 18 24 / 48 / 120 VAC 0-70 Hz
VOLTAGE CONTROL	MP type / ARK 60A-12V or 25A-24V, or similar, with rectifier, charging voltage controller and dump load	MP type / ARK similar 120A-24V or 20A-120V,ou, with rectifier, charging voltage controller and dump load	MP type / ARK similar 120A-24V or 20A-120V,ou, with rectifier, charging voltage controller and dump load	MP type 85A-120V or 215A-48V, or similar, with rectifier, charging voltage controller and dump load
POWER CONTROL	Inclined hinged tail	Inclined hinged tail	Inclined hinged tail	Inclined hinged tail
ORIENTATION SYSTEM	Passive by tail	Passive by tail	Passive by tail	Passive by tail
BRAKE SYSTEM	None / Brake switch with MP controller	None / Brake switch with MP controller	None / Brake switch with MP controller	None / Brake switch with MP controller
TOWER	Galvanized steel tube Guyed tower 6-18 m	Galvanized steel tube Guyed tower 6-18 m	Galvanized steel tube Guyed tower 6-18 m	Galvanized steel tube Guyed tower 6-18 m
ANNUAL YIELD **Average wind speed** 4 m/s 5 m/s 6 m/s 7 m/s 8 m/s	kWh/yr. 1.070 1.845 2.725 3.660 4.575	kWh/ayr. 2.930 4.825 6.685 8.540 10.205	kWh/yr. 2.310 4.650 7.505 10.180 12.825	kWh/yr. 6.420 14.640 22.500 28.215 32.140









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