# The Dunlite Wind Generator

The advent of the wind plant some 40 years ago brought a revolution in power generation for people in remote areas.

It produced a form of cheap, reliable, maintenance free DC power for operation of domestic and farm electrical implements.

If a power generating plant was already in service the wind plant provided a reduction in engine running hours to give longer engine life and lower fuel bills.

Expansion of the electricity supply authorities to outback areas caused a decline in domestic sales for a period but with the sudden fuel crises and the inability by supply authorities to meet the ever increasing demand for more power, in some areas, the wind plant has become popular again as a prime source of domestic power. And with the ecologists crying out for less pollution the wind plant is a natural.

The wind plant has also found itself in the ever growing field of telecommunications where a relatively small source of reliable DC power generation is required to maintain batteries for microwave repeater stations.

What better generator could there be? The wind plant will operate fully automatically with virtually nil maintenance, no fuel worries or cost and a constant cycling operation, which is ideal for battery maintenance.

## DESCRIPTION

The brushless model employs a multipole, totally enclosed, 3 phase alternator with full wave silicon rectifying diodes to convert the generated alternating voltage to D.C.

All wind plants must of necessity be Direct Current generators since the windmill is a variable speed device and would produce a varying frequency A.C. supply if used as an alternator.

The Dunlite generator is available in a range of output voltages viz 12 volt, 24 volt, 32 volts, 48 volt and 110 volt. Some decrease in maximum output is experienced with the lower voltage machines due to the large currents produced.

The windmill employs a true aerofoil section 3 blade propeller, designed to give maximum performance in all wind conditions. Bob weights attached to the propeller blades throw out centrifugally when wind conditions are tending to overspeed the generator. Movement of the blades causes a "feathering" effect into the wind and the generator slows down.

This relieves stress on the propeller and the tower as well as preventing overspeeding.

The full feathering effect means that these plants are quite safe in winds to a maximum of 80 m.p.h.

Special short propellers are available on request, for wind speeds to a maximum of 140 m.p.h., however, some loss of output occurs at lower wind speeds with these propellers.

A further optional extra available on request is magnetic latching on the feathering operation of the propeller. This provides a snap action release of the blade to the feathering position allowing the machine to operate nearer the maximum output speed in gusty wind conditions.

Application

What voltage:- The correct voltage wind plant to use for a specific application is normally dictated by the voltage rating of the equipment to be used keeping in mind that if the wind plant is some distance from the battery and load centre, then voltage drop in the lines will be experienced. Voltage drop is proportional to the current carried by the conductor so higher voltage systems such as 48 volt and 110 volt will experience less problem in this direction since the same conductor will handle less current per watt of load for these systems.

What size plant:- There are a number of factors to consider when determining the size or number of plants to be employed at any particular situation.

(1) The load:- This must be calculated as an average drain of energy from the battery during every 24 hour period. The output of the wind plant or plants must be able to restore this lost energy to the battery while this load is being maintained. If the load appears too large for one wind plant there is no reason why plants may not be parallelled to give twice the output. This is a relatively simple procedure with the addition of a blocking diode to the control cubicle to isolate the plants from one another.

(2) Prevailing Wind Conditions:- As power for the batteries can only be generated when the wind blows it is necessary to know the periods of windy conditions and velocities that will be experienced. This information is available to some degree from weather bureaus - however the actual location of the plant should be checked to ensure that it is not sheltered by hills, trees, houses etc. in front of or behind the plant. Plant performance can be effected by objects within 100 yards radius.

A range of wind tower heights is available to assist in difficult installations (40' - 60').

It may be necessary to install the wind plant some distance away from the load to ensure a direct wind stream. The wind plant has a large reserve and can handle distances up to 300 yards without loss of effectiveness.

The diagram shows the curve of generator output with respect to average wind speed. It can be seen that the plant commences to charge at approx. 8 m.p.h. and develops full output at approx. 25 m.p.h. From this curve it should be possible to calculate

the size of the plant to restore the drained energy of the battery during wind periods. Some reserve should be included to ensure the batteries are "gassed" to give longer cell life.

Example — Estimated load per day on a 24 volt battery

Load (1) 8 amps! for 4 hours
Load (2) 12 amps for 3 hours
Load (3) 6 amps for 10 hours
Load (4) 2 amps for 7 hours

The daily draw on the battery by these loads:-

Load (1) x 24 volts = 8x24x4 = 768 Watt hrs.
Load (2) x 24 volts = 12x24x3 = 864 Watt hrs.
Load (3) x 24 volts = .6x24x10= 1440 Watt hrs.
Load (4) x 24 volts = 2x24x7 = 336 Watt hrs.
Total battery draw 3408 Watt hrs.

Estimated wind conditions at site per day
Wind blows at 10 mph for 10 hrs.
16 mph for 2 hrs.
l8 mph for 2 hrs.

By use of the curve:-

Power restored to the battery during windy conditions would be:-
(1) 75 watts for 10 hours = 750 watt hrs.
(2) 600 watts for 2 hours = 1200 watt hrs.
(3) 975 watts for 2 hours = 1950 watt hrs.
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3900 watt hrs.

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This means that the 2000 watt machine could amply handle the load under the given conditions.

Where long periods between windy conditions exist it will be necessary to install larger capacity battery banks to cover the windless periods. However, under these conditions it may also be necessary to use multiple generators to recharge the batteries during the short windy periods. To estimate the size of system for these conditions it may be necessary to do the calculations before mentioned for a period of 1 or 2 months instead of per day.

The high speed propeller assembly should only be required where wind speeds are expected to exceed 80 m.p.h. A 'ferodo' type brake is fitted

to all units to lock the propeller for occassional storm periods.

Magnetic latching is normally only specified by Telecom Australia.

Basic Construction

Propeller:- Dr. No. 3450

This consists of an aluminium hub assembly containing the sliding governor, the oscillation of which is smoothed out by shock absorber units. The 3 blades are mounted on shafts, which rotate on bearings fitted in the hub assembly. These shafts act in unison, under the combined forces of wind and speed on the blades, to move the governor assembly in and out against the action of a central spring and the shock absorber units, providing automatic "feathering" of the blades and so preventing excessive generator speeds and strain on the tower.

GENERATOR:- Dr. No. 3447

The totally enclosed generator housing contains a three phase, 8 pole, brushless alternator driven by the propeller through a 5:1 ratio gear box employing helical cut gears running in an oil bath.

The output from the alternator is rectified through a full wave bridge rectifier using silicon diodes to give a steady D.C. output of minimum ripple factor.

HEAD ASSEMBLY
(Turn Table) Dr. No. 3451

The turntable assembly into which the generator is seated rotates on sealed, heavy duty bearings. The centre shaft, enclosed in the turntable, carries the 3 gold fished sliprings to transfer the generated current to the load and for the connection of field supply to the alternator. These rings terminate at a weather shrouded terminal- strip at the base of the turntable.

TOWER CAP Dr. No. 3451

Consists of a fabricated steel, 4 stud mounting plate, with 3 stub angle legs, conforming to the configuration of the top of the 3 legged tower, to which it is bolted. The 4 studs correspond to the holes provided in the base of the turntable assembly, and lock nuts provide a means of levelling the turntable.

TOWER Dr. No. 114

40ft, 50ft, or 60ft. 3 legged, heavy duty galvanised steel tower with wire bracing and steel ladder.

CONTROL CUBICLE including regulator Dr. No. 1021-73

Cubicle houses ammeter, voltmeter voltage regulator and terminal block. Also reverse blocking diode if required. The voltage regulator for brushless machines operates as follows:-

When the generator begins rotating, a voltage due to the residual magnetic flux, will be generated in the single phase centre tapped field supply winding incorporated in the main stator. The 50V. rectified supply is applied to the exciter field via the voltage regulator unit which controls the amount of current fed into the field. This takes the form of rapidly switched pulses, which supply just sufficient average current to maintain the generator output voltage at the desired level.

This current ranges from 150-300mA, no load to full load, and varies from cold to hot operating conditions.

INSTALLATION

Points regarding the location of the wind plant have been made earlier. It is important where the wind generator is situated some distance from the battery and load, that the control cubicle is mounted as close as possible to the battery bank.

This ensures that the regulator is sensing the actual battery voltage and will automatically adjust the generator voltage to overcome line voltage drop between the generator and batteries.

Concise instructions for erection of the tower and suggestions for easier installation of the wind generator unit are included in the handbook supplied with each plant.

Some suggested aids such as a jury mast and generator lifting bracket will facilitate installation where a large number of plants are to be erected. Details of these aids are available on request.

Finally a note on improvements to our generator design.

Design improvements and modifications to our wind plants as suggested by customers such as Telecom have resulted in a complete reliable, rugged unit for fully automatic D.C. power generation.

e.g.

(1) All previous cast iron section such as the body, head assembly and propeller boss are now of die cast, corrosion resistant aluminium alloy.

(2) The gearbox propeller shaft is manufactured from high tensile steel.

(3) The propeller blade shafts are manufactured from stainless steel.

(4) All external nuts and bolts (except the tower) are stainless steel.

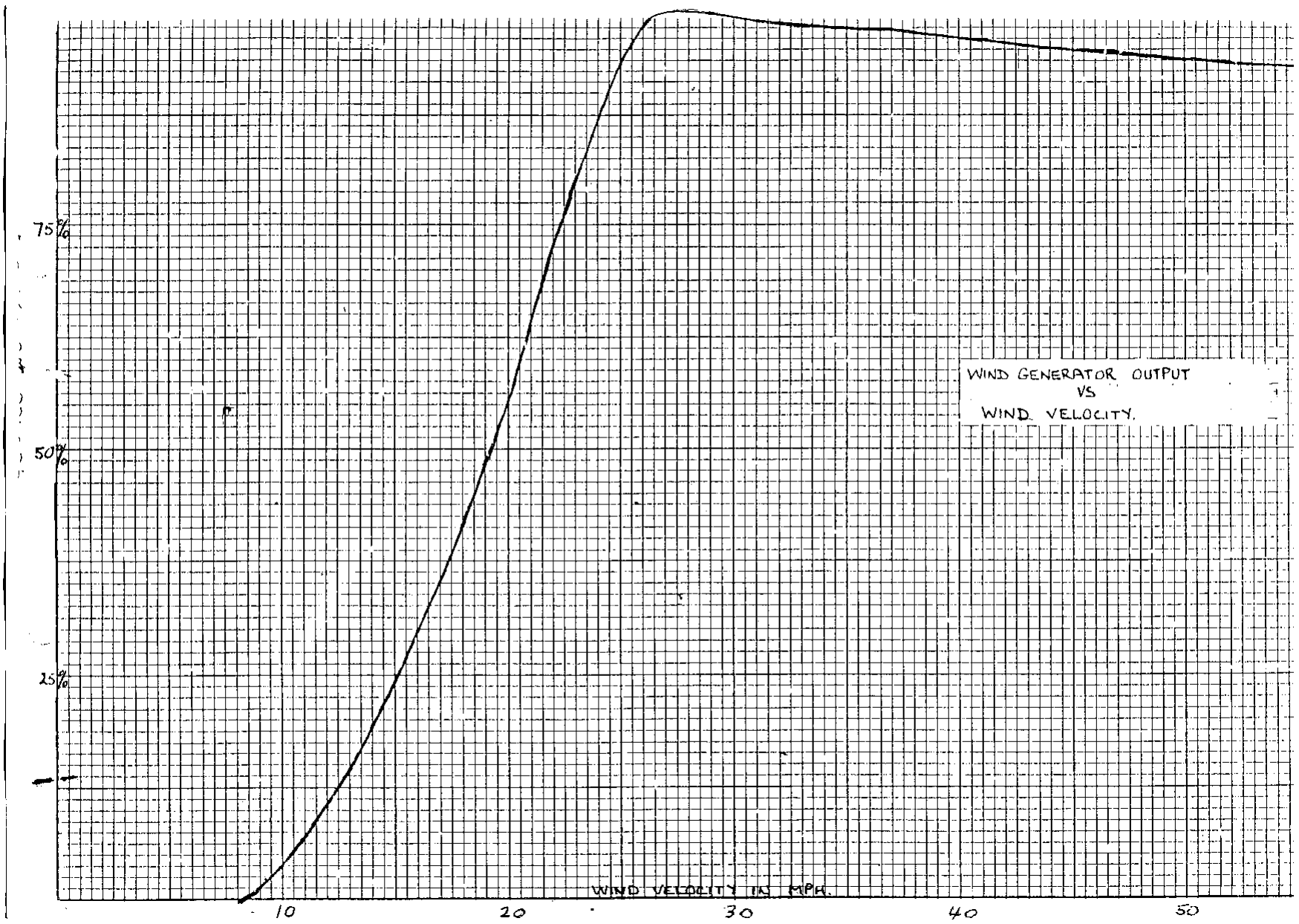
(5) All bearings are sealed roller bearings with special all temperature lubrication.

(6) Turntable sliprings are gold-flashed against corrosion.

(7) Stainless steel propeller blades are available on request.

(8) Magnetic latching of the propeller feathering system for higher efficiency operation in light wind areas is available on request.

(9) A unit capable of generating 5kw is currently under design.


75%
50%
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WIND GENERATOR OUTPUT
VS
WIND VELOCITY.
WIND VELOCITY IN MPH.
10
20
30
40
50