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ENERGY IN WIND OVER *DAKSHIN GANGOTRI* AND *NOVOLAZAREVSKAYA* IN ANTARCTICA

During the third expedition in 1983-84 one permanent station, named *Dakshin Gangotri* (Lat. 70° S, Long. 12° E and elevation 27 m) and another temporary station called *Maitree* near Russian station *Novo* (Lat. 70° 40′ S, Long. 11° 49′ E and elevation 87 m) as shown in Fig. 1 were established. The various energy needs of these two stations are presently being met by steam boilers and diesel generating sets. The fuels required for this purpose have to be transported from main lands situated thousands of kilometres away from Antarctica and stored there in large quantities. This is very costly, laborious and time consuming. A need was, therefore, felt to identify local energy resources. Wind and solar energy are the two abundant sources of energy, which if harnessed can, perhaps, cater to the total energy needs of the entire Indian stations in Antarctica. Solar energy at latitude 70° S where Indian stations are situated is available only for three to four months, whereas, strong winds are available throughout the year. Therefore, it appears to be an ideal choice of making use of wind energy over there.

In the present study the author has made an attempt to investigate in the field of renewable source of wind energy available in nature by estimating the wind power potential over *Dakshin Gangotri* [DG] and *Novolazarevskaya* (Novo) in Antarctica.

2. *Data and analysis* — The data for Novo have been taken from *Hand Book of Antarctic Climate* (1977) and for DG from *Indian Expeditions to Antarctica* (1985). This volume consists of the data which have been subjected to routine checking and pertains to First, Second and Third Expeditions. The data of the remaining expeditions have not yet been published and, therefore, could not be utilised in the present study. During the three expeditions, 3507 surface observations were taken at three hourly intervals. The analysis of surface winds is based on these observations and that of Novo for 13 years period from 1961 to 1973. The contemporary data of Novo could not be utilised because of its non-availability.

The wind energy associated with a wind flow of air density ρ and speed V over area A is given by :

$$P = 1/2\ \rho\ AV^3$$

This is the total power which is available from the wind. As the power is proportional to the cube of the wind speed, the wind speed plays a dominant role in power generation by the wind flow.

In order to obtain monthly values of power density, *i.e.*, the power per unit area normal to the direction of wind, the wind speeds have been divided into ten classes (2.5-4.5, 4.5-6.5, ..., 18.5-20. 5 and >20.5 m/s) and then monthly percentage frequency distribution of winds and their duration in these speed classes have been computed. From these, the monthly values of wind power density have been determined in accordance to WMO (1981).

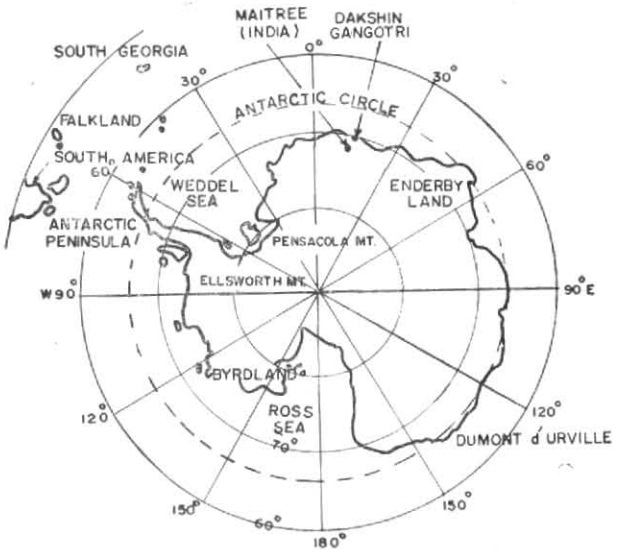

Fig. 1. Location map of Antarctica

TABLE 1

Monthly frequency occurrence f (in%) hour of occurrence h and wind power P (in kwh) for DG and Novo

	DG			Novo		
	f	h	P	f	h	P
Jan	61.85	460	211.8	84.43	628	225.3
Feb	85.94	599	593.6	93.36	648	505.5
Mar	68.03	679	1946.1	91.12	677	1228.0
Apr	69.18	498	2605.4	91.62	660	1427.8
May	78.64	585	2473.1	90.55	718	1716.4
Jun	75.84	546	1914.2	91.48	660	1991.0
Jul	59.68	444	784.8	89.25	665	853.1
Aug	48.80	363	379.4	88.28	657	1299.5
Sep	69.58	377	2976.2	87.12	630	998.9
Oct	73.40	546	3309.1	91.62	678	1157.2
Nov	81.03	582	2481.8	90.13	650	794.2
Dec	55.24	411	194.5	84.54	630	327.3

While computing the wind power density, the monthly density of air is taken as 1.29 kgm^{-3}. Small variations on account of pressure and temperature changes have not been taken into consideration as these changes are small as compared to fluctuations in wind speed V.

3. *Results and discussions* — The distribution of wind power density in $kwhm^{-2}$ and the number of hours for each month and the year as a whole is given in Table 1 for DG and Novo.

The table is self-explanatory, however, the salient points are as follows :

(*i*) In the months of December and January the wind power corresponding to wind speed >3.5 m/s is minimum both for DG and Novo. The values lie between 194.5 and 211.8 kwhm^{-2} and 225.3 & 327.3 kwhm^{-2} for DG and Novo respectively.

(*ii*) It is seen that over DG the frequency corresponding to winds more than and equal to 3.5 m/s is minimum (48.8%) in August. However, the power analysis shows that wind power is more than that of even in December and January. This is because stronger winds (more than 18.5 m/s) have higher frequencies as compared to the month of January and December.

(*iii*) The highest wind power density is available in October (3309.1 kwhm^{-2}) and June (1991.0 kwhm^{-2}) over DG and Novo respectively.

(*iv*) Annual value of wind power over DG is 19870 kwhm^{-2} while over Novo it is almost half (11809 kwhm^{-2}) to that of DG. It is due to the reason that DG, because of its nearness to the coast and its terrain, experiences much stronger winds under the combined effect of katabatic and gradient wind flow (Bhukan Lal 1987).

Thus, over DG and *Maitree* (which it is adjacent to Novo) where energy from the wind is to supplement energy from the other sources, the quantum of energy that would be available from wind being known for the different months, a more realistic planning for other energy sources and projects utilising wind power for the different months of the year and the year as a whole becomes feasible.

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