RATING OF SOLAR ENERGY SYSTEMS IN NAIROBI

By

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ABSTRACT

In this study, solar power potential in Nairobi was investigated using data from Dagoretti Meteorological station. Hourly radiation records within the period 1976-1990 were analysed by statistical methods. The first method involved the estimation of few missing records by the use of the Angstrom equation in order to make the data set continuous.The second method subjected both the estimated and archived radiation records to quality control tests to ascertain their reliability for the study.The third method subjected the quality controlled data to probability and frequency analyses in order to determine the normal diurnal and seasonal expectations of the available solar energy resources. This involved the derivation of probabilities associated with various solar energy ratings. The fourth method examined the temporal variabilty patterns of the various class ratings in order to determine the optimum ratings for solar power use during the individual months. The final part of the study was devoted to the development of the minimum, optimum and maximum rating curves for Nairobi area.

Results from the quality control tests revealed that the estimated and archived data used in the study were homogeneous and subsequently reliable for the study. From the frequency analysis,it was observed that the occurrences of low power class ratings were concentrated in the early part

of the morning and late afternoon hours. It was further observed from the same analysis that class ratings below 800 W/M^2 exhibit bimodal distributions with the two peaks centred in the morning and afternoon hours respectively. Results from probability analysis indicated that: (i) All solar powered systems rated 100 watts/m^2 and below can be operated throughout the day around Nairobi and those with ratings of 101-400 watts/m^2 cannot be operated before 8 a.m. and after 5 p.m. (ii) The chances of operating solar powered systems rated between 401 and 600 watts/m^2 are very low before 9a.m. and after 4 p.m. (iii) Solar systems with ratings of 601-800 watts/m^2 have low operational potential before 10 a.m. and after 3 p.m. while the maximum operational potential for solar systems with ratings of 801-1000 watts/m^2 is between 11 a.m. and 2 p.m. (iv) The potential for the direct operation of solar systems rated above 1000 watts/m^2 is very low around Nairobi and their application will be restricted to between 11 a.m. and 2 p.m. Results from the computed measures of dispersion indicated that most months had one reliable(optimum) rating. The average optimum rating for the whole year was within 201-300 watts/m^2 power range. Reliable ratings for July and August were below the average optimum rating for the whole year. The final part of the study provided the expected minimum, optimum and maximum rating curves which are crucial for the planning and utilization of solar power around Nairobi. The curves for example indicate

that in January, any solar powered system rated 200 watts/m^2 can be operated for a minimum, optimum and maximum duration of 2, 10.3 and 12 hours respectively. Such computations can be extended to any other ratings between 0 and 1300 watts/m^2 power levels.

Finally, it may be concluded from the study that solar power potential is quite promising in Nairobi, especially at the small and medium output levels.