HYDRAULICS RESEARCH DIVISION

Technical Note

DATE: May 30, 1977 REPORT NO: 77-5

TITLE: "Wind and Wave Energy"

AUTHOR(S): T.M. Dick

REASON FOR REPORT: The Director of CCIW requested a brief review of the "Salter" machine for abstracting energy from waves vis-a-vis methods to obtain energy from the wind.

CORRESPONDENCE FILE NO. 2520

TECH. NOTE 77-5

Wind Energy

Table 1 contains data extracted from a monograph in SCIENCE DIMENSION for the characteristics of a modern, vertical axis windmill. Table 2 normalizes the data to the energy abstracted per metre of windmill diameter. It is interesting to note that as the machine increases in size, the energy abstracted per metre width increases, mainly because the other dimension also increases.

Normalizing the width dimension allows direct comparison with the wave energy.

Wave Energy

In S.I. units, the wave power of gravity waves in fresh water is given by

$$\text{Power} = 0.478\ H^2T$$

where H is the wave height in metres

T is the wave period in seconds.

The wave power has been calculated for a range of wind speeds and fetches of 100, 60 and 49 miles.

Comparison of Energy Density

The wind power density is shown in graphical form in Fig. 1 and the wave power density in Fig. 2.

Direct comparison is easily achieved by superimposing Fig. 1 on Fig. 2.

Obviously, for the usual "working" wind range, the energy potential from the waves is higher because of the integrating effect of the waves. However, efficiencies of energy abstraction are lower and, according to Baird & Mogridge (2), the "Salter" machine has about 50% efficiency.

The wave power as shown in Fig. 2, is typical of the Great Lakes environment but Salter, Baird and Modridge give power densities in the oceans of several times greater. For example, at Tofino, B.C., the average is 30 kw/m and at Logy Bay, Nfld., the average is 27.6 kw/m.

Conclusion

It is theoretically possible to obtain more energy from waves than directly from the wind. At this time the technology for windmills is much more advanced than wave energy extraction devices.

At remote stations the possibility of wave energy as a source of power should not be ruled out but until technology advances, the costs are likely to be higher.

Since wind and wave energy are unsteady sources, Salter suggests that averaging could be achieved by using the power to disassociate water into hydrogen and oxygen and then burn the hydrogen to recover the power by more conventional methods.

T.M. Dick

WIND POWER

Table 1. Wind Power from Vertical Axis Windmill as Function of Wind Speed and Rotor Diameter.

Wind Speed mph	Power kw 20'D 6.1 mD	40'D 12.2 m	60'D 18.3 m	80'D 24.4 m
10	.5	2.0	5.0	10.0
15	1.8	7.0	17.0	35.0
20	4.0	18.0	40.0	80.0
25	8.0	30.0	80.0	120.0
30	16.0	60.0	140.0	250.0

Table 2. Wind Power Per Metre as Function of Wind Speed and Rotor Diameter.

Wind Speed mph	6.1 m	12.2 m	18.3 m	24.4 m
10	0.08	.16	.27	.41
15	0.30	.57	.93	1.43
20	0.59	1.48	2.18	3.28
25	1.31	2.46	4.37	4.92
30	2.62	4.92	7.65	10.25

REFERENCES

S.H. Salter "Wave Power". NATURE. Vol. 249, June 21, 1974. No. 5459.

W.F. Baird & G.R. Mogridge "Estimates of the Power of Wind-Genrated Water Waves at Some Canadian Coastal Locations." Hydraulics Laboratory Technical Report. National Research Council. LTR-HY 53. August 1976.

National REsearch Council SCIENCE DIMENSION. Vol. 8/5. 1976.

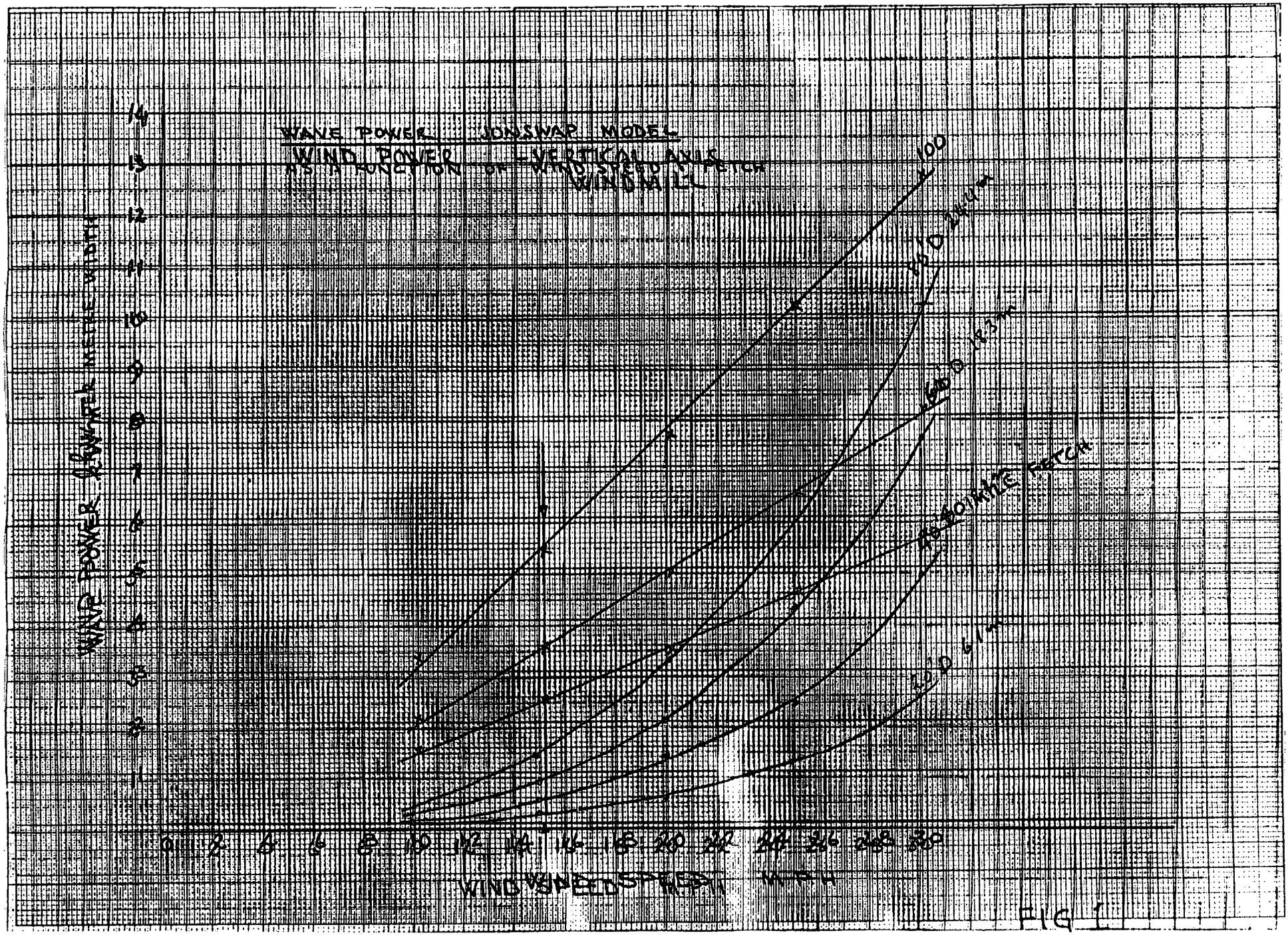

FIG 1