

OPEN AIR EXPERIMENTS ON ROTORS

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1. Experimental facilities

Several institutes have been contributed to the IEA-Annexes XIV and XVII and the experimental set-up of the participants involved are the base for this course. Imperial College, IC (and Rutherford Appleton Laboratory) is not included in this survey because the program was not really suited for a realistic comparison due to many problems during the measurements. The base and details of the facilities are highlighted in the table below. Pictures of two partners are added and show the layout, the combination of test turbine and met mast(s).

Table 1: Rotor details.

Geometry	ECN	DUT	NREL	MIE	RISØ
Designation	Aerpac 25 WPX			Aerpac APX-40	LM 8.2
Number of blades	2	2	3	3	3
Rotor diameter	27.66m	10.0m	10.06m	10.0m	19.0m
Cone	5. deg.	No	3.41 deg.	No	No
Tilt	5. deg.	No	No	No	5. deg.
Taper	Yes	No	No	Yes	Yes
Twist	12 deg.	No	Phase III-IV Twisted At $r/R=.25$, 30 deg	12 deg.	15 deg
Pitch	Adjustable	Adjustable	Adjustable	Adjustable	Approx. -1.8°
Airfoil series	NACA 44xx	NLF(1)-0416	S809	DU 91-W2-250 DU 93-W-210 NACA 63-618	NACA 63-2xx
Thickness Root-Tip	26% - 16%	16%	20.95%	25% - 18%	24.5% - 17.5%
Start aerodynamic blade part	28%	20%	14%	27%	27%
Tower	Pile	Pile	Pile	Pile	Lattice
Hub height	22.4m	15.3m	17.03m	13.3m	29.3m
Remarks	Up-wind turbine	Up-wind turbine	Mainly Down-wind Free yaw	Up-wind turbine	Up-wind turbine

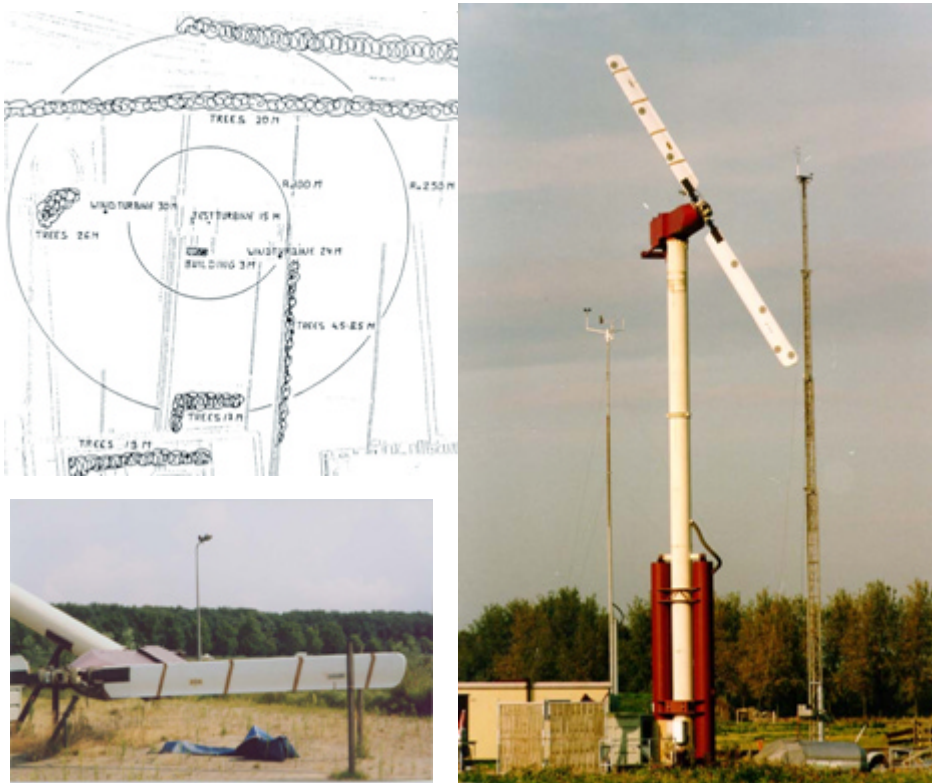


Figure 1, Overview of experimental set-up at Delft (the Netherlands)

The measurements can be divided in two and focussed on environmental properties and the aerodynamic rotor performance. The environmental parameters of concern are the wind speed and directions, wind shear and some additional properties like barometric pressure and temperature to e.g. derive the air density.

Most important are the aerodynamic properties and the measurement devices which are located mainly at the blade.

Some are at the root others along the span. The specific equipment which is fitted can easily be distracted from table 2.

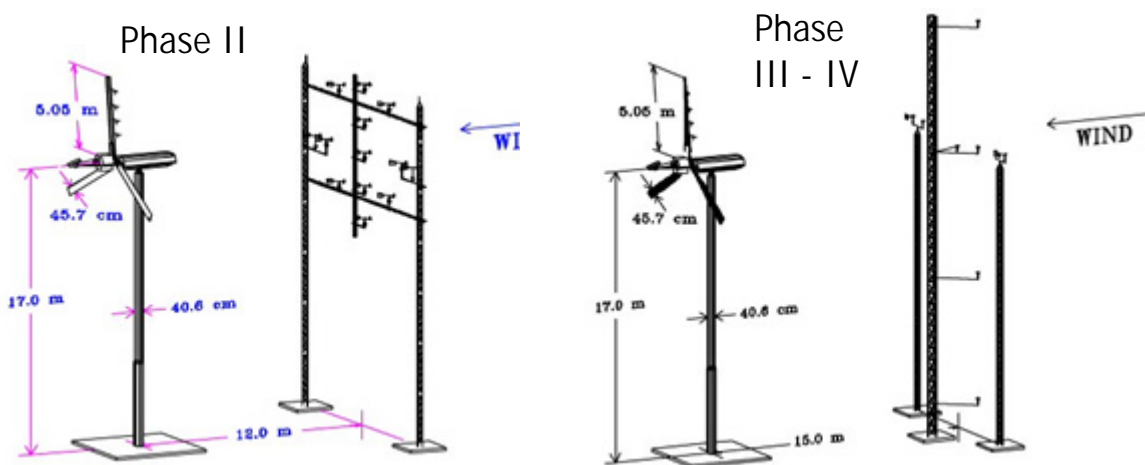


Figure 2, Overview of the experimental set-ups at NREL (Boulder, Colorado, USA)