

APRS World's early-2017 Wind Turbine Update

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APRS World, LLC

www.aprsworld.com



History

- APRS World was founded in 2006 with focus on designing and manufacturing small wind resource assessment hardware
- Resource assessment turned into performance monitoring
- Performance monitoring turned into turbine testing for customers
- Testing turned into development for customers

APRS World's Micro Wind Turbines

- WT10 - 1 meter rotor diameter
- WT14 – 1.4 meter rotor diameter
- Designed and extensively tested for harsh arctic and Antarctic environments
- Selling since 2011 and approximately 300 units around the world in
 - scientific and industrial applications
 - military power systems
- Available in 12 / 24 / 48 volt battery charging with various yaw and blade attachment options

Arctic and sub-Arctic

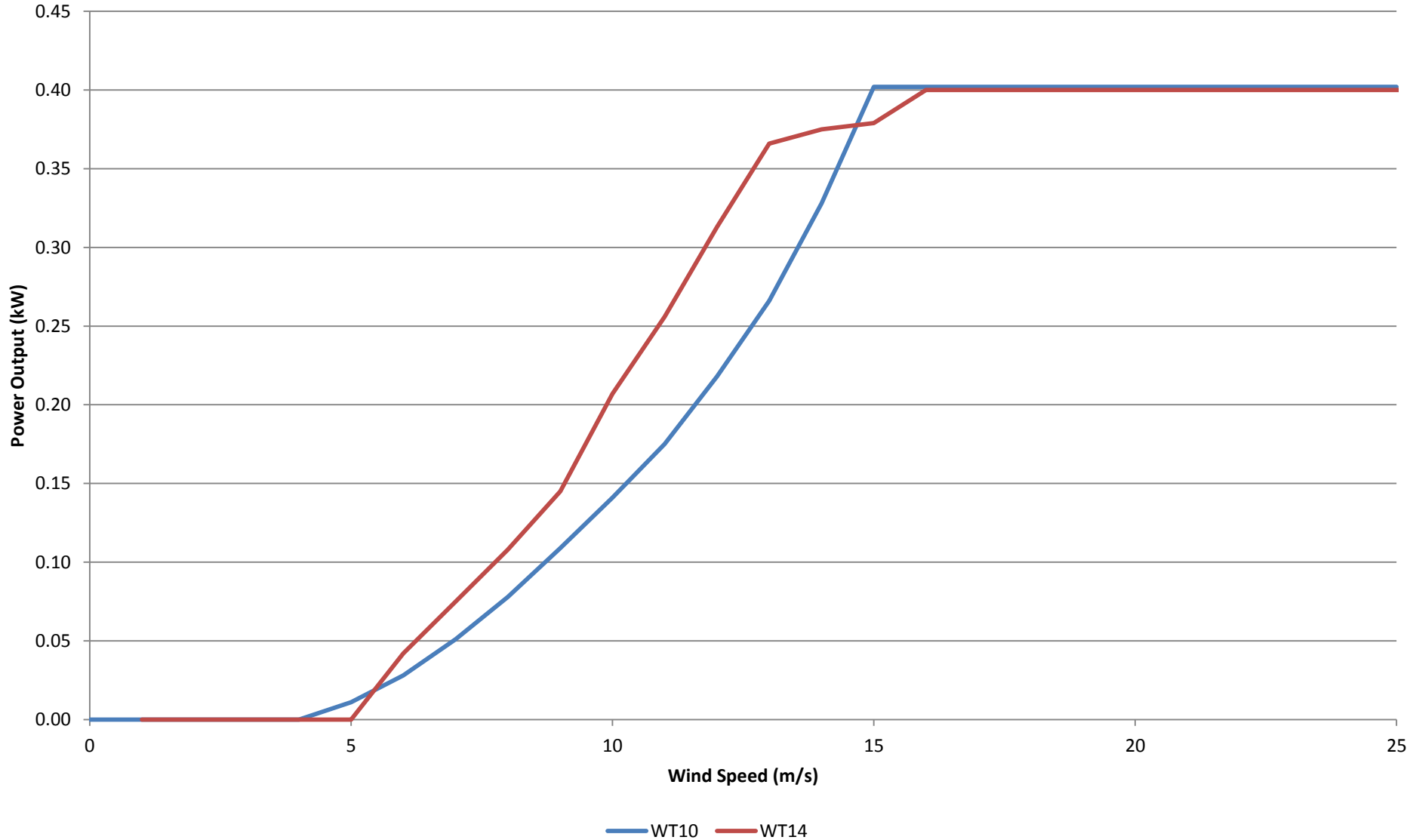


Antarctic



WT10 / WT14

Representative Power Curves



WT1x Field Failures in last year

- Turbine on a tiny island off of Kodiak Island, AK shed its tail ... but continued to operate
- Power system contained in extremely well insulated enclosure overheated and caused lithium battery thermal run-away and presumed site destruction

WT1x Improvements

- Tails are now made from stainless steel that won't cyclically fatigue the same way the aluminum did
- New custom turbine controller in development
 - self powered with zero consumption from battery
 - two integrated dump controls with thermostatic control
 - auxiliary output to drive shorting or open circuiting relay
 - communications for monitoring and SCADA

APRS World's

New / Old and Small / Big Turbine

- In 2016 we purchased the assets of Black Island Wind Turbines, LLC, the latest purveyor of the HR3 “High Reliability” 3kW turbine
- The HR3 is a funky old school turbine, but it has a great track record



NORTH
WIND

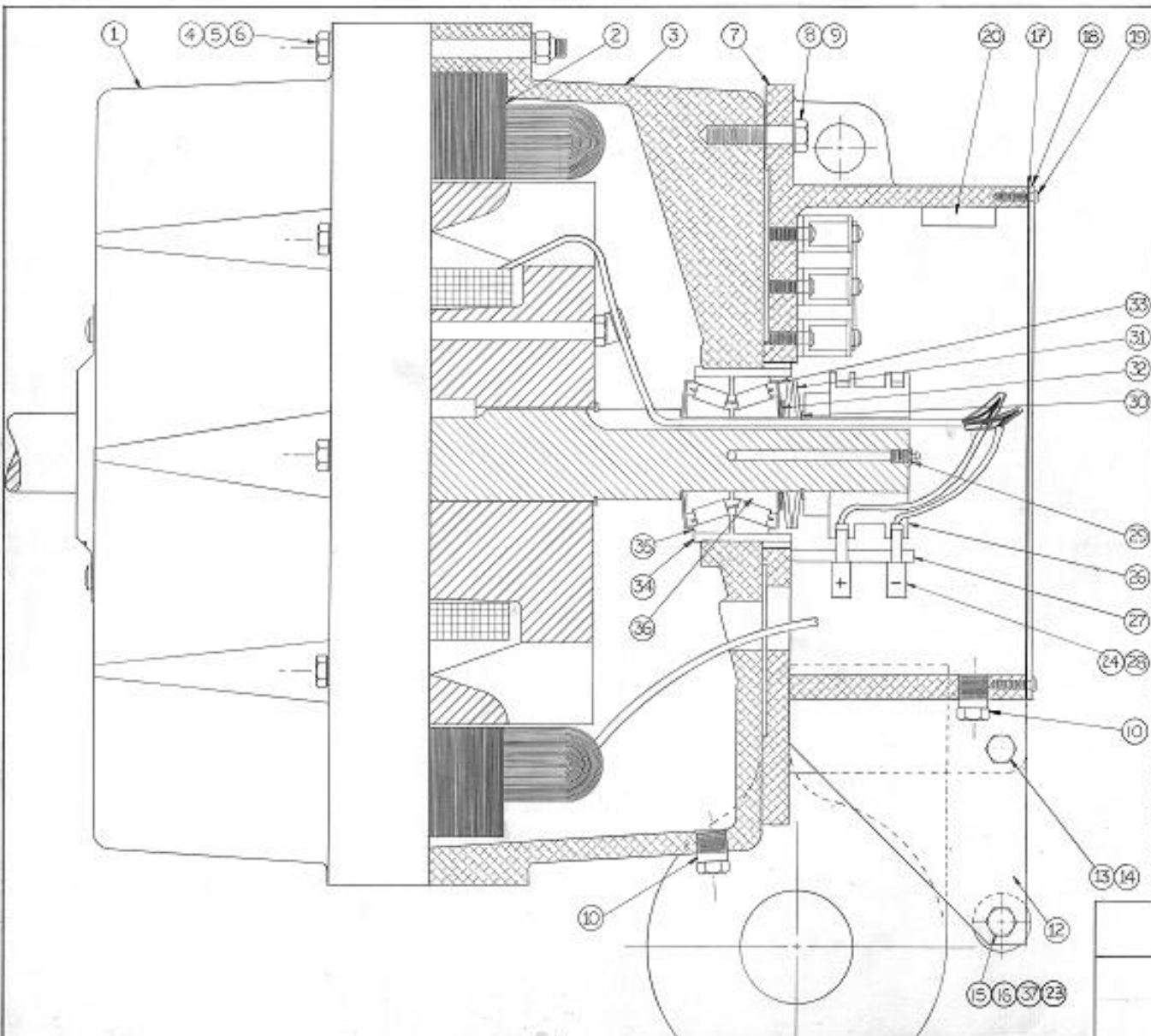




HR2 / HR3 History

- Developed in late 1970's through early 1980's
 - with government contracts and funding
- “Hundreds” sold and installed between 1980 and 2000 by “North Wind Power Co” et al
- Black Island Wind Turbines LLC acquires property, makes minor improvements, and produces a very small batch of turbines in 2011
 - primarily in support of NSF and USAF turbines in operation in Antarctica





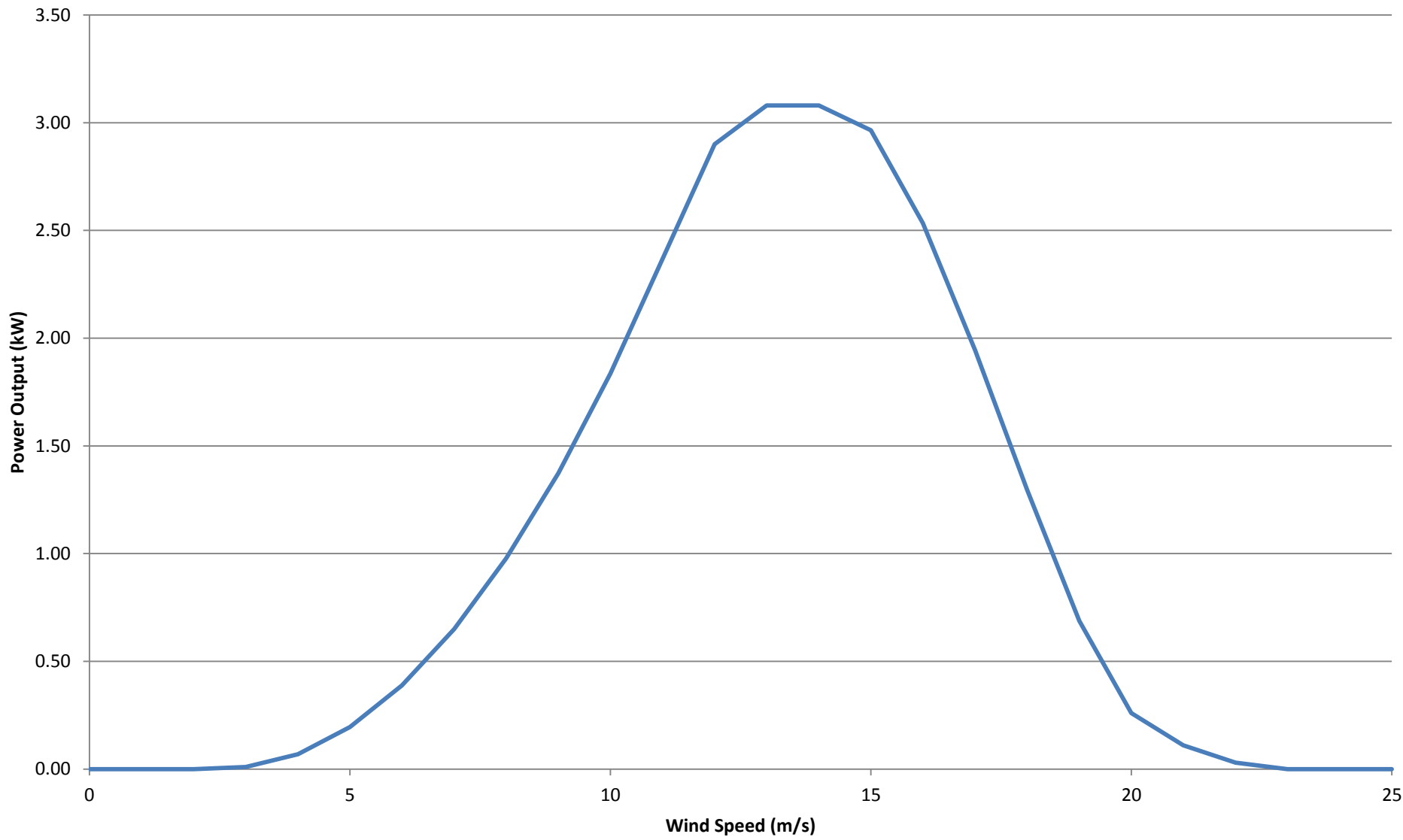
QTY	DESCRIPTION	PART NO.
37	1 NUT 3/16 NYLOCK PL	12940
36	1 CONE REAR BEARING	2K145
35	2 CUP REAR BEARING	2K144
34	1 BEARING RETAINER REAR	2K159-07
33	1 SEAL REAR BEARING	2K146
32	2 WASHER THRUST	2K149
31	2 WASHER BELLVILLE	2K148
30	1 RING RETAINING	29170
29	1 GREASE FITTING	29402
28	2 BRUSHHOLDER	2K397
27	2 BRUSHHOLDER STUD	2K396
26	1 SUP RING ASSEMBLY	2K140
25	6 A/C PRESSURTS SST	2K353
24	2 BRUSH FIELD	2K308
23	2 WASHER DELRIN	2K282
22	4 DRIVE SCREW	
21	1 LOGO NORTH WIND	29422
20	1 CORROSION INHIBITOR	2K305
19	4 SCREW 3/16x3/8 SST	22026
18	1 DIODE COVER PLATE	2K390-01
17	1 BASKET, PGM	30300
16	1 BOLT 3/8x2 SHLDR SST	23075
15	1 PULLOUT PULLEY	2K378-03
14	1 NUT 3/8 SST NYLOCK	23442
13	1 BOLT 3/8x2 1/2 SST	23120
12	1 PULLOUT BRACKET SST	2K370-01
11	2 A/C BUMPER	2K342
10	1 BREATHER	2K160
9	5 LOCKWASHER 3/8 SST	23420
8	5 BOLT 3/8-16x1 1/2 SST	23054
7	1 A/C	2K310-16
6	16 WASHER 3/8 SST SAB	23412
5	5 NUT 3/8 SST NYLOCK	23442
4	5 BOLT 3/8-16x3 SST	23240
3	1 END BELL REAR	2K150-05
2	1 STATOR COMPLETE	2K112-00
1	1 ALTERNATOR ASM	2K100
SYMBQTY	DESCRIPTION	PART NO.

- PARTS LIST -

NORTH WIND POWER CO		
P. 002868 APR 2002		
ALTERNATOR / A/C ASSEMBLY		
REV D	2K302	REV 01
SCALE: NONE	SHEET 1 OF 2	

HR3

Representative Power Curve

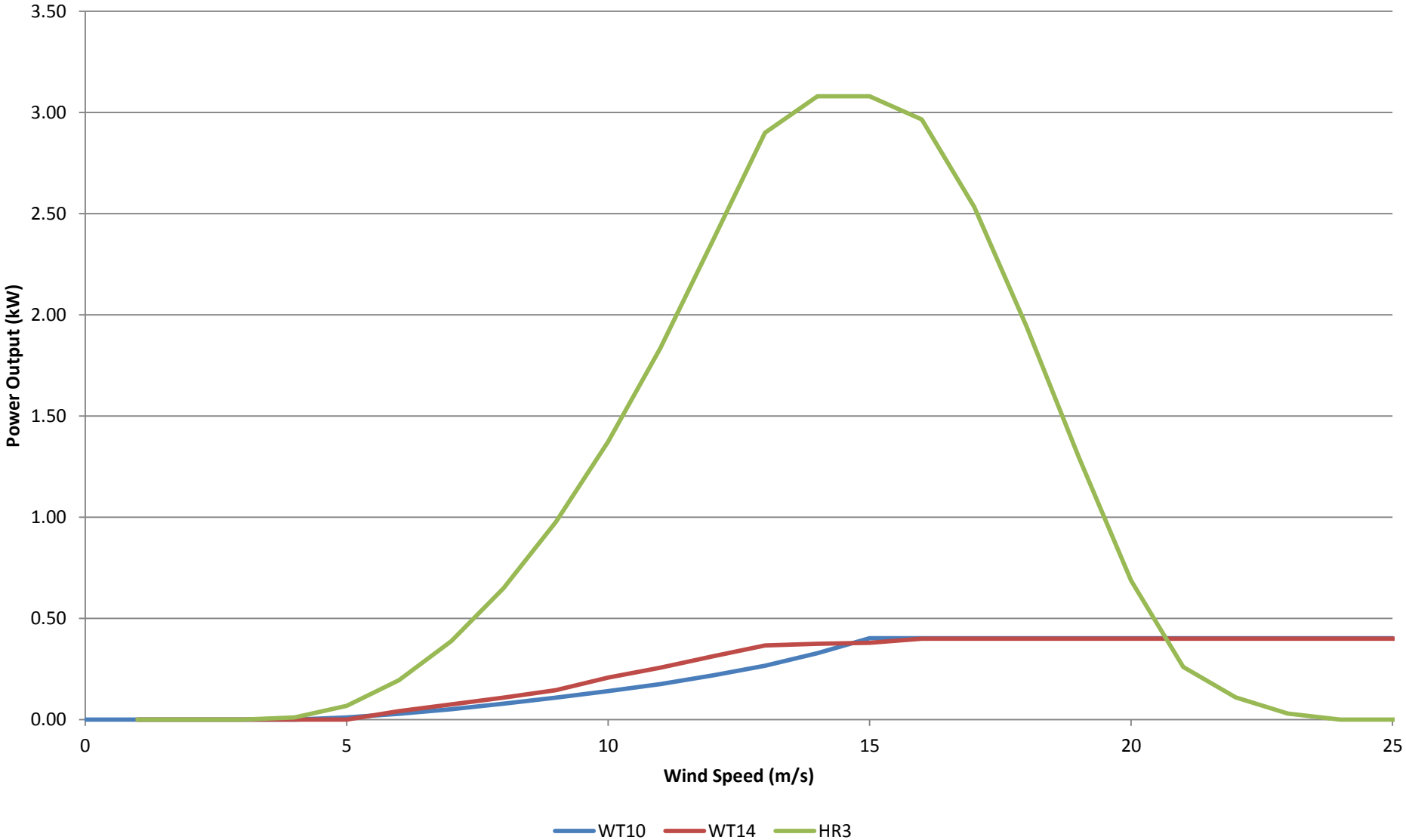


WT1x and HR3 Comparison

	WT10	WT14	HR3	
"Rating"	400		3,000	watts
Max Power	750		3,000	watts
Rotor Diameter	1.0	1.4	5.2	meters
Weight	11	12	356	kg
Generator Type	Permanent Magnet		Wound Rotor Synchronous	
Blade Material	Glass Filled Nylon		Laminated Wood	
Speed Control	Blade Flutter		Passive Pitch (Variable Axis)	
Tower, typical	Rohn 25G or 45G		Rohn 45GSR	
Price, typical	\$3,600		\$38,750	USD

WT10 / WT14 / HR3

Representative Power Curves



HR3 Compliments to WT1x

- Same Locations
 - dark windy places
- High reliability, well tested, mature
- Similar infrastructure requirements
 - same size towers
 - same site construction equipment
 - hand and small helicopter liftable
 - similar power output and handling
- Customer overlap
- Premium product and premium price
 - still not for homes



HR3 Divergence from WT1x

- Old “tooled” design leads to old manufacturing methods
 - cast parts that are very expensive in low volumes
 - carved wood blades that are expensive at any volume
 - heavy components from pre CAD and FEA days
 - near obsolete and single sourced vendor parts
- Almost all other APRS World products have been developed in house

DRAWING STARTED		DATE		NORTH WIND POWER CO.	
B. RODEKER		23 APR 84		FIELD COIL	
DRAWN					
CHECKED					
ENGR					
SIZE	CODE IDENT NO.			REV.	
C	2K126	2K126		1	
SCALE FULL			SHEET		1 of 1

HR3 Plans (the obvious stuff)

- Continued service, support, and parts for Northern Power and Black Island Wind Turbines HR3 products
- Sales of new HR3A turbines
 - “A” designator for APRS World models
- Offer APRS World field service and installation for existing HR3 and new HR3A’s world wide



HR3 Plans (the APRS World touch)

- Institute continuous improvements to HR3A
 - product improvements from customers and field testing
 - manufacturing improvements and migration to lower volume manufacturing techniques
- Install and operate HR3 and HR3A turbines at our Minnesota and Utah test sites
- Be responsive to customers needs and provide complete solutions





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Information on our products:
<http://www.aprsworld.com/>

