APRS World WT10 / WT14 Wind Turbine Update for 2016 Polar Technology Conference

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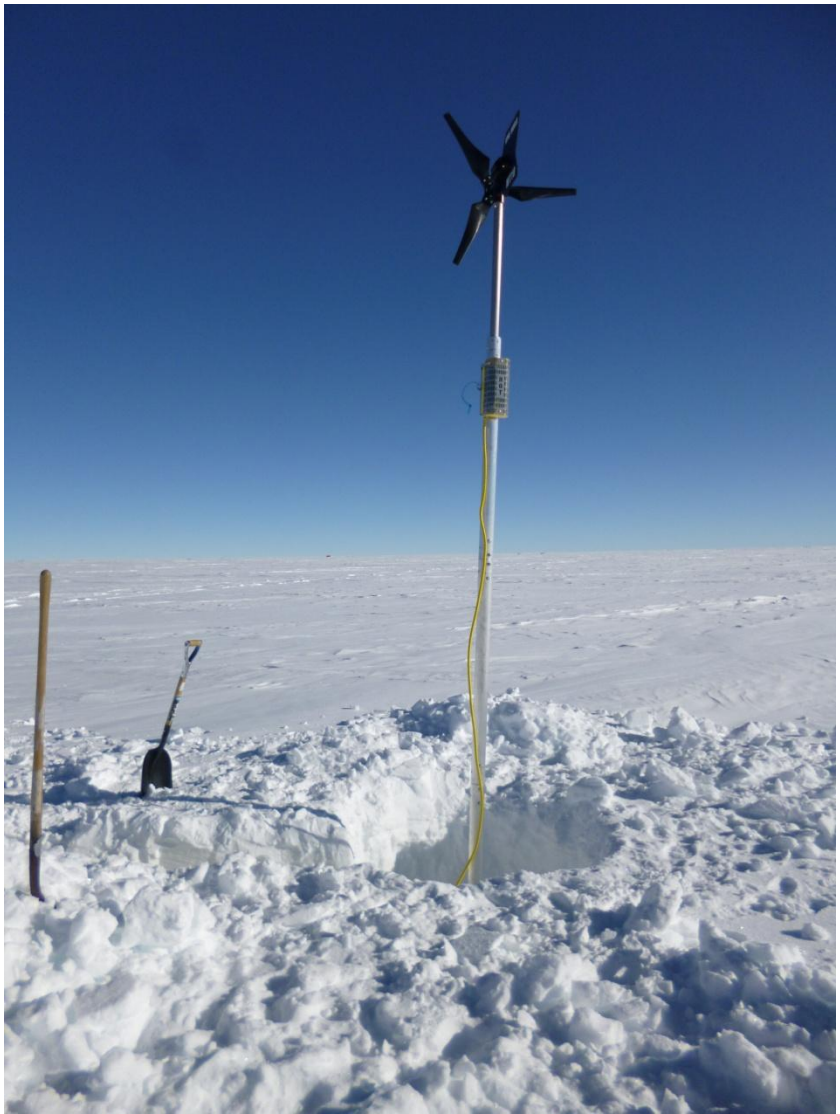
APRS WORLD, LLC

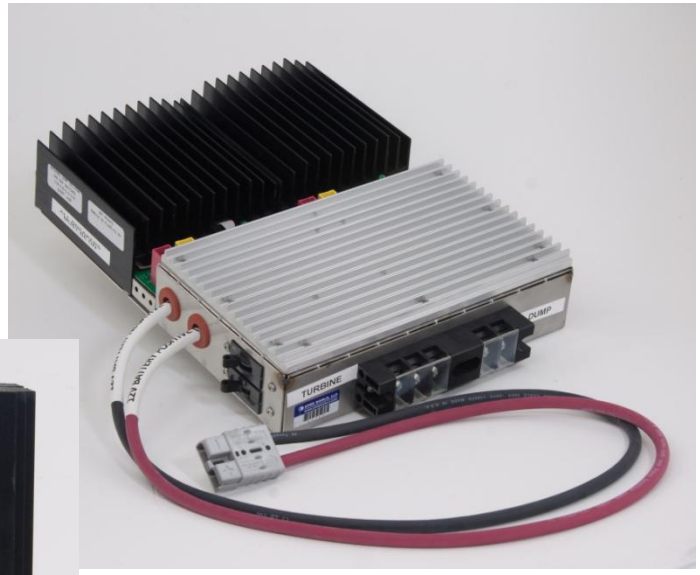
South Pole, Antarctica vicinity for IRIS/PASSCAL

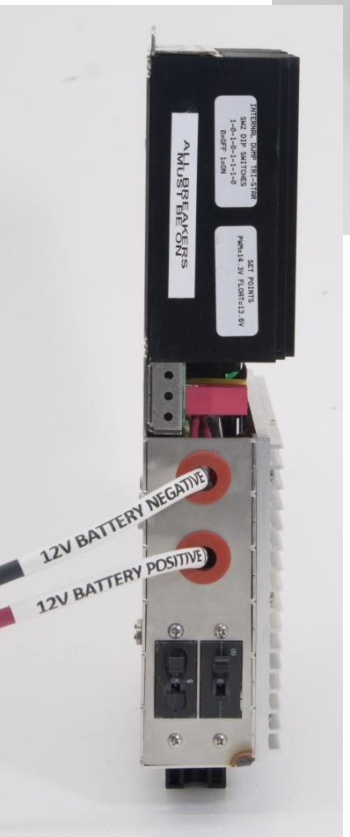


Photos by Jason Hebert (IRIS / PASSCAL)

- WT10 for heating enclosure and charging 12 volt battery
- Experimental snow anchored mast

Heating Panel



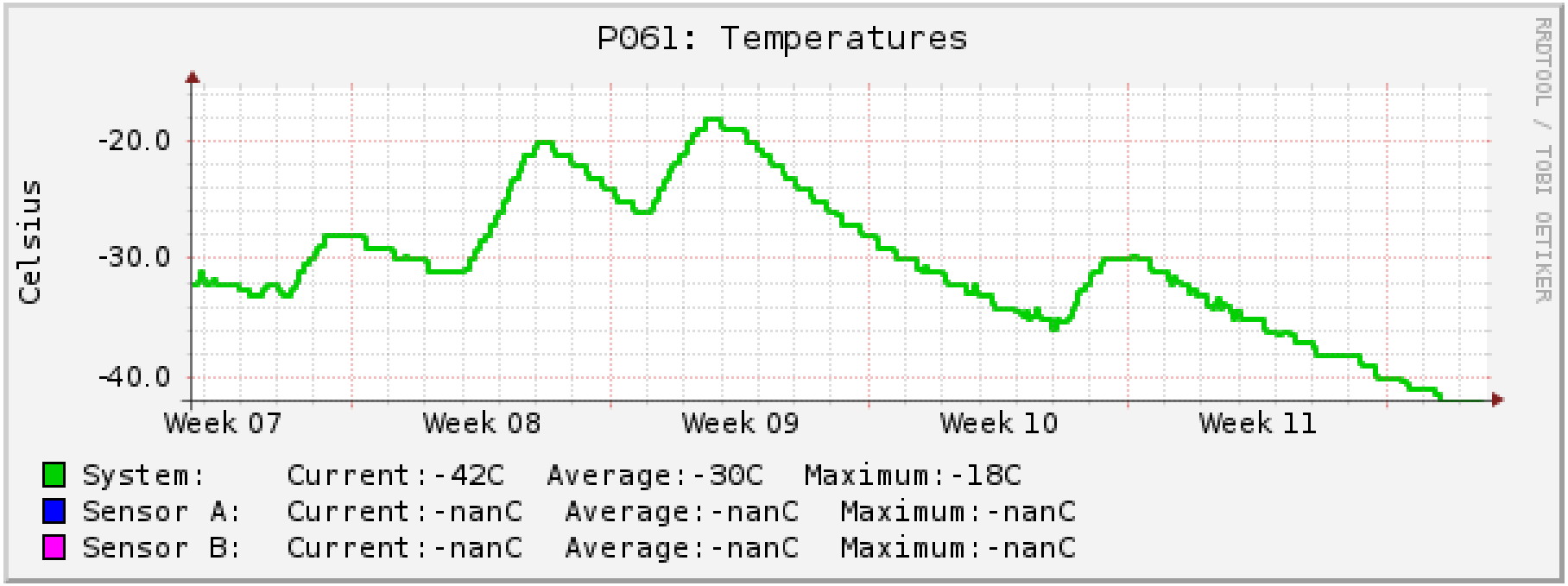


- Charges battery
- Heats enclosure until set point is obtained
- Dumps excess power to dump load on turbine mast
- Incorporates all turbine control panel electronics
  - stop switch, rectifier, power distribution, circuit breakers, dump controllers

Cold Weather WTAPRS Turbine

- Replaced grease in all bearings with Dow Molykote 33 low temperature grease
- Removed seals and used ultrasonic cleaner and Simple Green to remove original grease

Results at South Pole



- Primary objective is to heat enclosure to keep oscillator warm enough
- With sun down, any heating is from the wind turbine
- Limited wind at these sites. WT14 may be better.

Live data at https://xeos.passcal.nmt.edu/cgi-bin/details.cgi?stationid=1

McMurdo, Antarctica vicinity for IRIS/PASSCAL

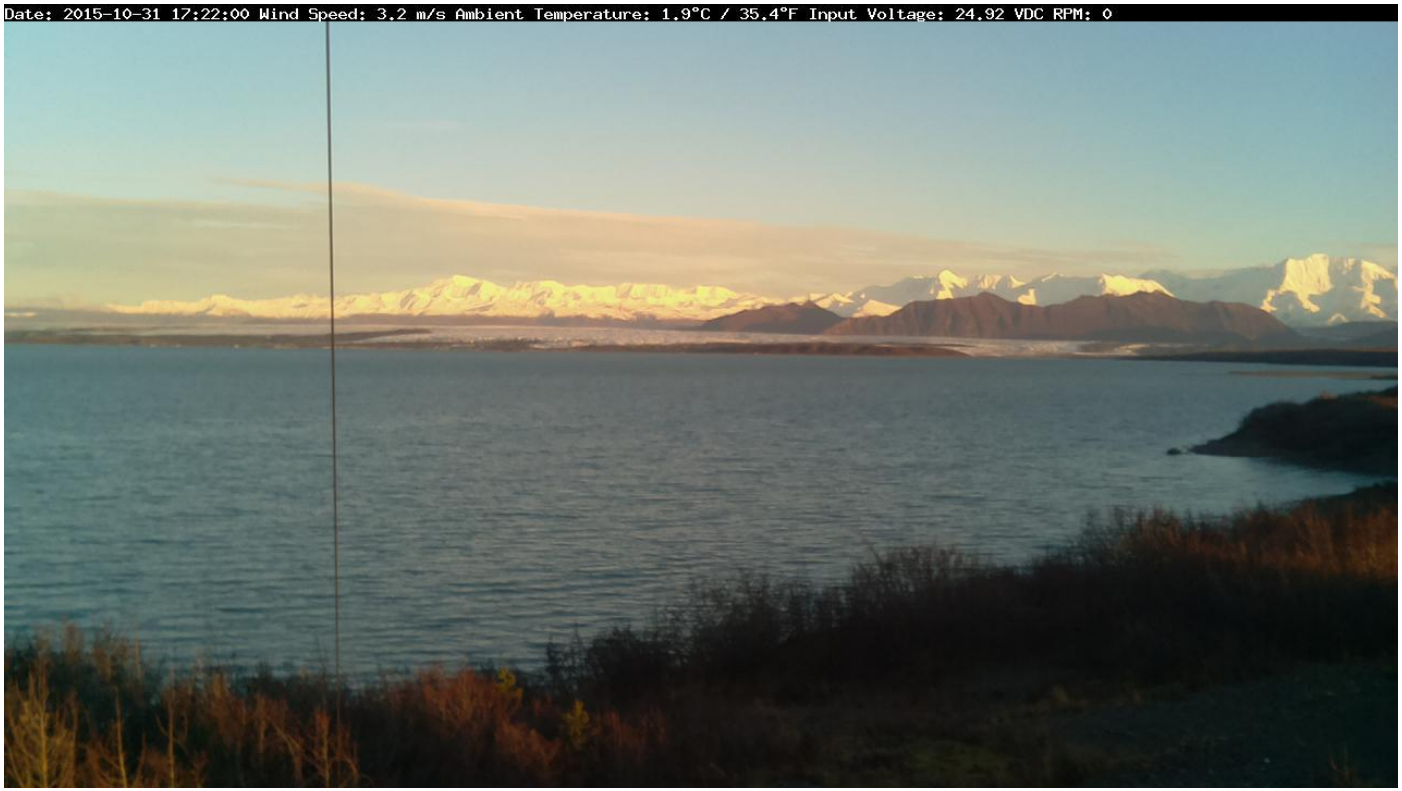
Live data at https://xeos.passcal.nmt.edu/cgi-bin/details.cgi?stationid=341

Bering Glacier, AK for Alaska Earthquake Center

- WT10 installed on existing communications tower
- Supplementing PV that wasn't meeting energy needs in winter months
- With turbine, system availability this winter was 100%!

Ethernet Weather Camera

- PCWX camera monitors turbine performance and site status
  - wind speed, turbine RPM / power output, battery voltage, temperatures
- Developed Ethernet (non-Wi-Fi) version for this project
- 100% uptime since installed July 2015

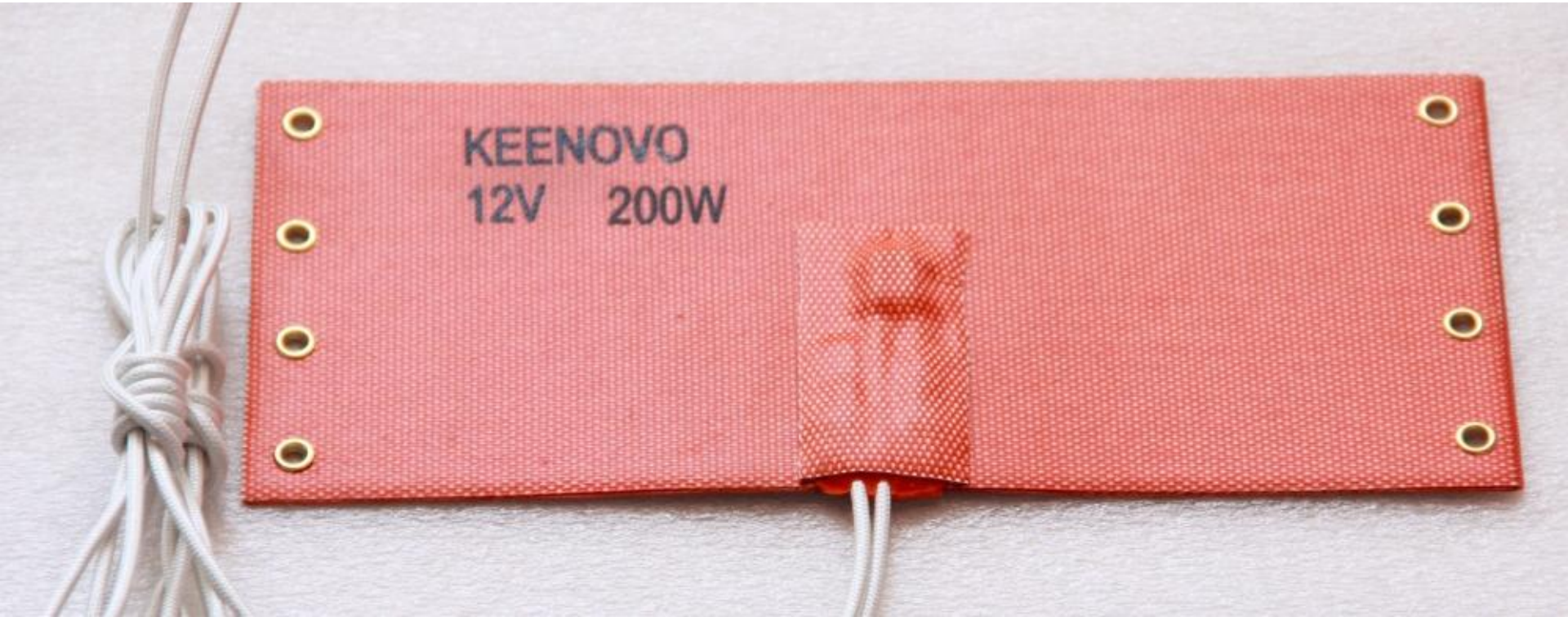


Juneau, AK
for Alaska Marine Exchange

- WT10 supplying power for ocean current sensor, ultrasonic weather station, and dock navigational light (10 to 20 watts continuous load)
- No solar, wind only
- Nearly 100% uptime since installed fall 2015

Heating Pad Dump Load

- Using adhesive backed silicone heat pad for dump load
- Mounts to extruded aluminum heat sink
- No exposed connections to corrode in marine environment



Modbus Bridge for Weather Camera

- Added capability to PCWX for RS-485 attached Modbus devices
- Now camera can directly monitor and control charge controllers, sensors, controllers, and many other industry standard widgets

NMEA0183 for Weather Camera

- Receive capability for NMEA0183 sensors
  - GPS, weather stations, clocks, marine sensors, etc
- Weather camera can now consist of two parts (camera and weather multi sensor) and provide full met station

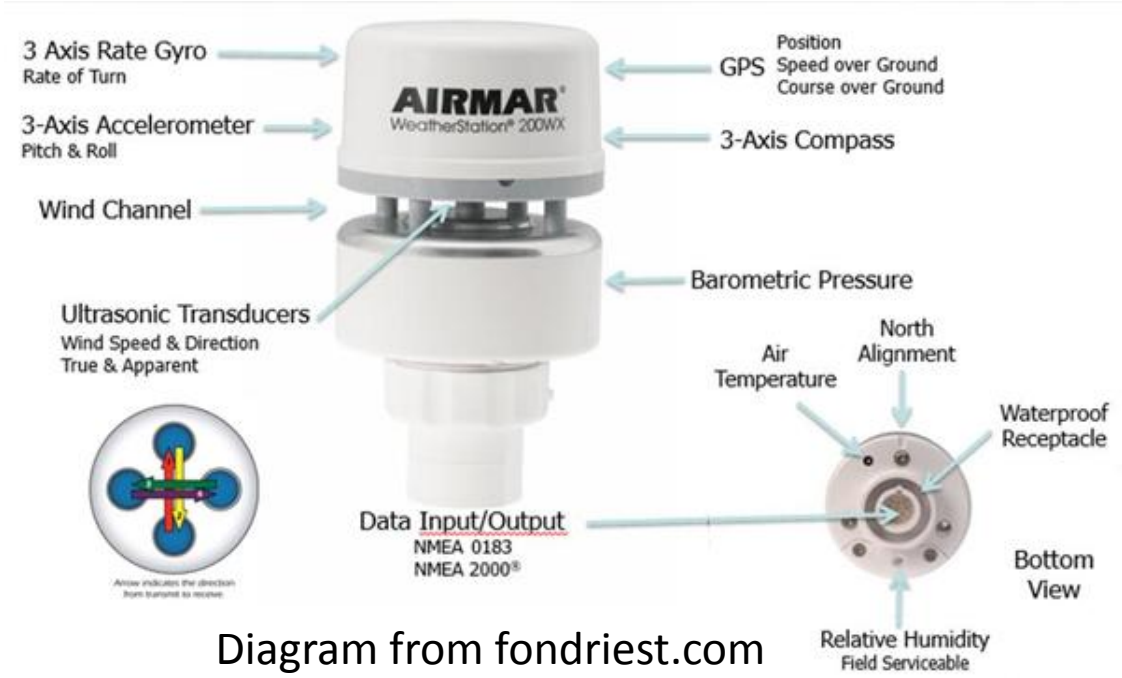


Diagram from fondriest.com

Arctic Ocean coast, Alaska for University of Alaska Fairbanks

- Four WT10 wind turbine per site
- Provide season power for coastal radar
- Deployed in multiple locations along coast

Photos by Hank Statscewich / University of Alaska Fairbanks

Quad Turbine Control Panel

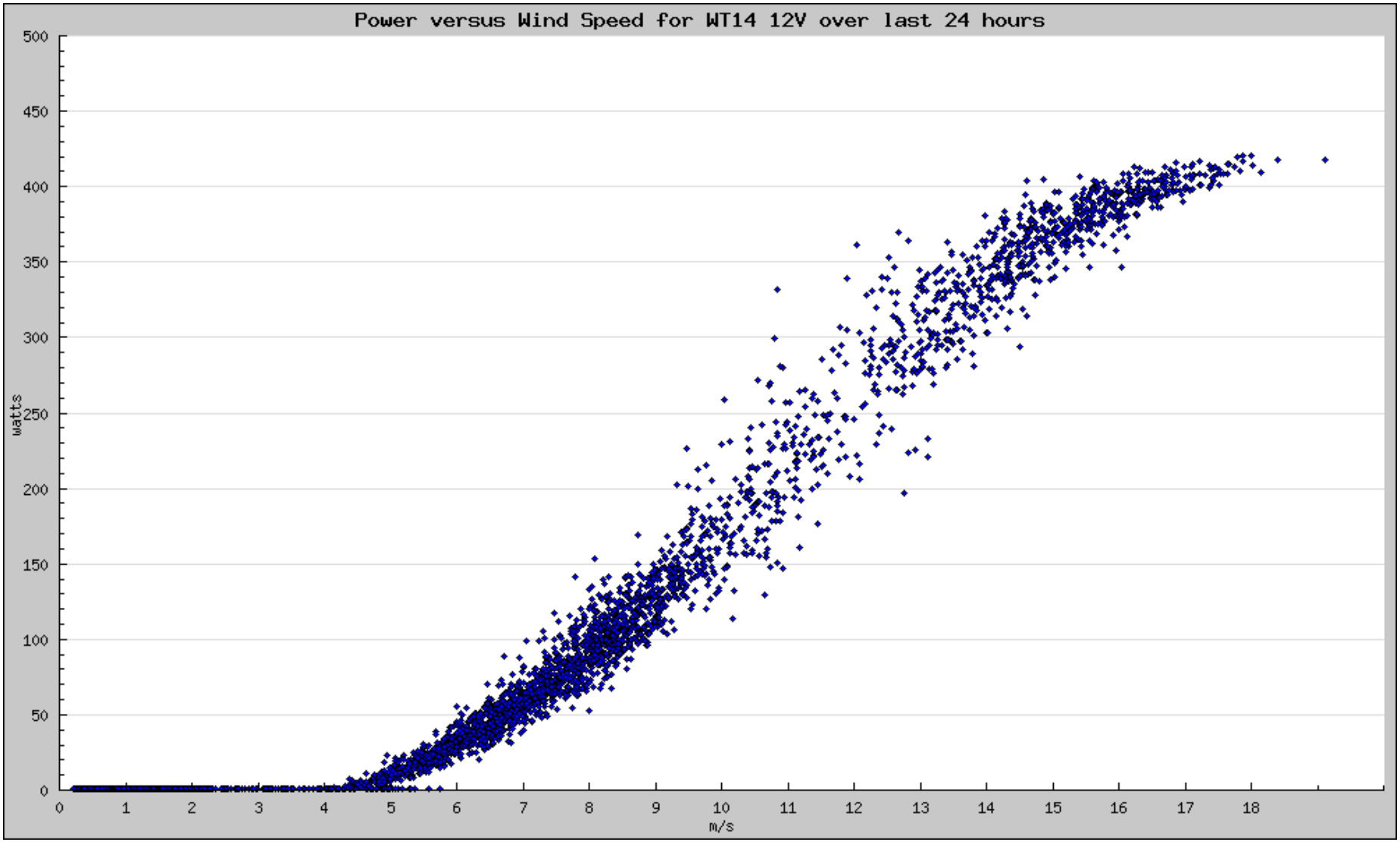
- Supports four turbines and internal and external temperature controlled dump loads

NOAA Climate Research Network various locations in Alaska

Photo provided by Mark Hall / NOAA

- Adding wind turbines to existing sites to increase availability
- Started with WT10 turbines and now going to WT14's
- Replacing fuel cells where there is wind resource

12 volt turbine winding



Spanish Fork, UT for APRS World testing

- Ongoing power performance and longevity testing
- Developing modified WT14 (WT13?) to reduce sound level

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