



Mariah Power Response to NREL Small Wind Testing, Chronology of Events

4/29/2009

Mariah Power thanks NREL and the staff at the Wind Technology Center for providing the opportunity to test the Windspire, and for sharing feedback in order to help us improve our product. That said, we were disappointed with the turbine component failures during the field testing at the National Renewable Energy Laboratory's Wind Technology Center (WTC) site, and the subsequent discontinuation of testing. The Windspire was a brand new product at the time testing began, and the unit provided for the test was one of our earliest production units.

In addition to testing at the WTC, Mariah Power deployed 100 units to the field as part of our 100 Unit Field Program and continued Independent testing. By selecting these diverse sites, some in extreme conditions, we tried to simulate the variety of conditions in which the Windspire was designed to operate. As a result of the WTC and these other programs, we were able to identify and rectify several product design issues early in our production phase.

The problems identified at the WTC and in the field have been closely analyzed and put through a rigorous engineering change order process to remedy. Consequently, the following changes in our design and manufacturing processes have been instituted:

- New air foils replace welded end plates. These end plates are now secured with stainless steel M8 fasteners.
- The safety rings are now segmented and attached with mechanical fasteners. These replaced the butt welded rings.
- The airfoil clamping system was redesigned which provides for a more concentric gripping force. These new opposing clamps secure the airfoils from slippage.
- We have engineered stiffer and straighter shafts, and added ¼ inch thickness to the base plate. These help improve longevity and address early modal/resonance disturbances.
- The loose nuts encountered on this test unit were not encountered on any of the other field units. We believe this issue arose on the test unit due to undue stress from poor shaft straightness (see above).
- A new clamping method was developed to secure the top shaft and generator in order to eliminate fretting.

In addition, Mariah Power has introduced other product upgrades since the first units were shipped. The benefit of a complete field test program and other independent test sites is that we can identify and address potential issues quickly, and also make improvements to the existing technology.

We were disappointed that our inverter had so many issues on the electrical side. Several factors have been changed in our inverter since UL approval, to improve reliability, power output and safety. We are working closely with ETL to incorporate these changes in our UL certification:

- Revised boost transformer to lower the internal temperature of the transformer
- Added thermal sensing to maximize wattage output while maintaining electrical integrity by shutting down when thermal limits are reached.
- Improved firmware control to better manage the power output and system control in high wind.

Finally, Mariah Power has implemented more quality control measures for its current production units. We have partnered with a top US manufacturing company, MasTech Manufacturing based in Manistee, Michigan. MasTech has manufactured for many top US and foreign car companies and is well known for its expertise in meeting stringent quality controls. We have put in place critical components to our new manufacturing processes:

- Hired AWS certified welders.
- Hired an ASQ certified quality engineer to manage the quality process at Mastech Manufacturing.
- Combined wrought multi-piece components into steel and aluminum castings.
- Put holding fixtures for component fabrication in place to provide consistent machining of the parts.
- Use plug and ring gauges for functional inspection of critical dimensions to ensure consistency of systems.

We are continuing and expanding our own third party testing programs to ensure we integrate testing methodologies and results into our own programs. We look forward to the upcoming AWEA standards for small wind turbines and testing against these requirements once ratified.

Respectfully Yours,

A handwritten signature in cursive script that reads "Mike Hess".

Mike Hess, on behalf of the entire Mariah Power team
(Signed for Mike Hess with his permission)